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PROGRESS REPORT ON RESEARCH AND RELATED SERVICE
APPLICABLE TO
→ SUGAR

Including Work in United States Department of Agriculture
and Cooperative Studies with
the State Experiment Stations

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Prepared for Use in Connection with the
February 1955 Meeting of the
Sugar Research and Marketing Advisory Committee

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. ulation of recommendations in regard to present and future programs;
. (2) Administrative use in program development, coordination and evaluation.
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UNITED STATES DEPARTMENT OF AGRICULTURE
Washington, D. C.
January 1955

FUNCTIONS OF ADVISORY COMMITTEES

The Sugar Research and Marketing Advisory Committee is one of a number of committees authorized by Congress in 1946 to advise the Department of Agriculture with respect to specific research and service programs.

The committees have been asked to consider all of the research and marketing service work of the Department in their respective fields. This is in recognition of the value the Department places upon the advice and counsel received and is in accord with suggestions of Congressional committee members who are directly concerned with the work.

These committees are performing an important function in advising with respect to the development of the Department's research and marketing service programs. However, it is recognized by members of Congress, committee members, and the Department that the implementing and administering of these programs are the responsibility of the Department

The functions of the advisory committeemen include:

1. Acquainting themselves with the problems of consumers, producers, all segments of the industry and of other groups, and presenting them for committee consideration.
2. Reviewing and evaluating the current research and marketing service programs of the Department, including work underway at Federal laboratories and field stations.
3. Recommending adjustments in the Department's program, including priorities for new work and expansion of work underway.
4. Developing a better understanding of the nature and value of the agricultural research program, explaining it to interested persons, groups and organizations and encouraging the wider and more rapid application of the findings of research.

USDA AGENCY ABBREVIATIONS

AGRICULTURAL RESEARCH SERVICE - ARS

AE	Agricultural Engineering Research Branch
ENT	Entomology Research Branch
FC	Field Crops Research Branch
HN	Human Nutrition Research Branch
NU	Northern Utilization Research Branch
SU	Southern Utilization Research Branch
WU	Western Utilization Research Branch

AGRICULTURAL MARKETING SERVICE - AMS

AEC	Agricultural Economics Division
AES	Agricultural Estimates Division
FVD	Fruit and Vegetable Division
MOC	Market Organization and Cost Branch

FOREIGN AGRICULTURAL SERVICE - FAS

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Much of the research on sugar covered in this report, particularly that relating to production is conducted cooperatively by the USDA agencies and the State Agricultural Experiment stations. This cooperative effort usually begins with the inception of the need for a job from farmer and industry contacts and extends by joint planning of work programs, cooperation in doing the research job, and, finally, making available the results on the joint effort. The detailed arrangements for the cooperative work vary considerably, depending upon the available facilities, financial support, and personnel and the State policies involved. In principal, the cooperative efforts by the USDA agencies and the State stations are planned so as to utilize to the best advantage the personnel and facilities of both agencies and to assure coordination of effort. In most of the report which follows, the detail required to explain specific cooperative relationship is omitted.

Most marketing service and education work covered in this report also involves varying degrees of cooperation between the USDA, State departments of agriculture and bureaus of markets, State Extension Service and industry groups.

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PROGRESS REPORT
FOR
SUGAR RESEARCH AND MARKETING ADVISORY COMMITTEE
February 23-25, 1955

I. PRODUCTION RESEARCH

A. PROGRESS ON WORK UNDER WAY

1. SUGAR BEETS

a. Production and Management

(1) August Plantings Catch On in the Imperial Valley FC-ARS

The techniques of August plantings of sugar beets in the Imperial Valley of California, previously reported as under test with the 1952-1953 and the 1953-1954 crops, are finding adoption among the sugar-beet growers there. The experiments had shown that sugar beets planted in August are ready for March and April harvest with good returns to the grower. It also had been shown that varieties that bolt too much in October plantings in the Imperial Valley may be planted in August and harvested before bolting occurs. This may, in the future, open up possibilities for a larger choice of varieties for the Imperial Valley and may afford a margin of safety with all varieties against excessive bolting.

(2) Supplemental Irrigation Saves Beet Crop FC-ARS

A severe spring drought and a short water supply that led to heavy abandonment of commercial fields of sugar beets in Colorado in 1954 were encountered in experimental work conducted in cooperation with the Colorado Agricultural Experiment Station. Supplemental irrigation saved the crop. Irrigation water from wells, which is becoming more generally available for early applications as well as a supplement to ditch water, will have a definite influence upon cultural practices. It will assure prompt emergence of early plantings and a longer growing season. Early plantings are more likely to suffer from frost injury and will show the greatest number of bolters, making more urgent the need for a frost-resistant non-bolting variety.

(3) Fertilizer Practices in Producing Monogerm Seed FC-ARS

The fertilization of sugar beets grown for seed presents problems different from the regular sugar-beet crop. With sugar beets grown for the factory, the best practice calls for liberal nitrogen applications to grow a large plant body. Late nitrogen applications may bring about strong vegetative growth at the expense of quality. With crops

grown for seed, fertilizer is applied to produce a strong growth in the fall. In the ensuing spring, liberal applications of nitrogen are made to the overwintered beets, and these continue, in contrast to beets for sugar, until bolting is under way, in order to obtain the highest seed yields. In tests, cooperative with the Oregon Agricultural Experiment Station, effects from 200 and 300 pounds of nitrogen per acre in the spring on monogerm sugar beets were studied. Phosphate and potassium applications were uniform over the plots. The monogerm seed produced, over the whole field, at the rate of 2,525 pounds of clean seed per acre--an excellent showing, considering the small size of monogerm seed. The strips receiving 300 pounds of nitrogen per acre averaged 250 pounds of seed higher than the strips receiving 200 pounds of nitrogen per acre. The higher nitrogen applications did not throw the monogerm types into a vegetative condition.

(4) Nutrients Hasten Seed Emergence and Growth

FC-ARS

In physiological studies of factors affecting seedling emergence and establishment, the role of mineral nutrients supplied to young plants as they germinate has been explored. Sand cultures supplied with solutions carrying varying quantities of mineral nutrients have clearly indicated that a scant nutrition may delay germination as much as two days and produce a spindling, retarded growth, even though final emergence in sand cultures may equal that from well-nourished ones. If the nutrients are added after a delay of a week, the initial setback persists, the plants remaining smaller than those finding nutrients available when emerging from the seed ball. Sugar beet seed carry far less reserve food than the seed of many other crop plants that establish themselves rapidly. The principles brought out by these physiological experiments are the basis for the general practice of applying fertilizer with the seed, and show the advantages that come from having plant nutrients available to the young sugar beet plant.

(5) Soil Moisture Affects Fertilizer Placement Practices

FC-ARS

There has been a marked change from the applications of small dosages of fertilizer--100 to 200 pounds per acre of a 4-16-4 fertilizer, for example--to the current practices of applying 500 to 1,000 pounds of a formulation such as a 10-10-10 mixture. Fertilizer placement studies in 1936, 1937, and 1938, cooperative with the Ohio Agricultural Experiment Station, had shown that with applications of 400 pounds or over of a standard fertilizer mixture, such as 4-16-4, it was best to place the fertilizer about one inch below and one inch to the side of the sugar beet seed to avoid the retardation or injury that frequently accompanied applications in the furrow with the seed. The experiments were

then far ahead of the general farm practice of applying only scanty amounts of fertilizer. With the very general increase in rates of application and the stronger formulas, fertilizer placement studies have again been instituted. One finding from the cooperative investigations in Michigan indicates that with the higher fertilizer rates, not only must the particular type of placement be taken into account, but moisture content of the soil is a basic consideration influencing the effects from the high fertilizer applications. Dry soils evoke retardations or even injuries to the root, not experienced when moisture levels are higher. Fundamentally, the problem concerned is one of osmotic pressure effects upon seed, and there is indication of differential responses among varieties to different osmotic pressures.

(6) Weed Control

FC-ARS

The development of equipment and methods of operation has lead to widespread mechanization of all phases of sugar beet production except for weed control in the spring. Thus, weed control becomes a limiting factor in the beet sugar industry and constitutes a major portion of the cost of production. Studies at Fargo, N. Dak. have continued with endothal as a selective pre-emergence, post-emergence, and pre-planting herbicide to control wild oats in sugar beets. Endothal was applied at various rates to wild oats in the seedling, tillering, jointing, and boot stages. In this study, a naturally occurring stand of Setaria lutescens emerged before the wild oats tillered. Control of wild oats in 1953 was not so good as that in previous years at this location. Treatments in the seedling stage gave the best control; however, 12 pounds of endothal resulted in only 75 percent control. Excellent control of Setaria was obtained with endothal at a rate of 2 pounds per acre. Endothal applied to weed-free sugar beets in the 2-3 leaf, 8-12 leaf, 17-18 leaf, and 18-24 leaf stage resulted in some reduction in yield, on a weight basis, at all stages of growth. Sugar percentages varied considerably between plots, but there appeared to be a slight reduction in sugar content as a result of the treatments.

Pre-planting treatments in which the herbicide is disked into the soil some time before planting have shown promise for the control of wild oats. Greenhouse trials with substituted N-phenyl carbamate and urea herbicides have shown that at rates of 2 pounds per acre, Isopropyl-N-phenyl carbamate, 3-chloro-isopropyl-N-phenyl carbamate, and Isopropyl-N-(3-methylphenyl)-carbamate gave good control of wild oats. These studies were expanded to field trials and the herbicides were applied at rates of 2 and 12 pounds active ingredient per acre. Wild oats were controlled at the 12-pound rate and the most effective herbicides were 3-chloro-isopropyl-N-phenyl carbamate, isopropyl-N-(3-methylphenyl)-carbamate, and isopropyl-N-phenyl carbamate respectively. Sugar beets showed considerable tolerance to the higher rates of all of the chemicals tested except 3-chloro-isopropyl-N-phenyl carbamate and the urea compounds.

A comprehensive study in Michigan which evaluated fertilization, thinning, and herbicides on sugar beets showed that significant reductions of both grasses and broad-leaved weeds were obtained with a mixture of 5 pounds of sodium trichloroacetate and 2 pounds of sodium pentachlorophenate applied shortly after sugar beet emergence. Beet stands were reduced by the sprays, but a stand sufficient to produce a satisfactory yield survived.

Post-emergence applications of a mixture of 5 pounds sodium trichloroacetic acid and 2 pounds endothal gave significant reductions in grass and broadleaved weeds and did not seriously affect beet stands. None of the rates of fertilization used produced any significant effects on weed populations or beet stands.

Significant reductions of weed populations in beet stands were produced by all thinning methods. Yields and sugar production were not affected by pre-emergence sprays, but post-emergence sprays reduced the number of beets at harvest time, yield per acre, percent sucrose, purity, and net sugar per acre.

The results obtained in 1953 indicate that pre-emergence sprays offer considerable aid in the control of weeds in sugar beets, without any reduction in sugar production. Post-emergence applications of the compounds tested in these trials may contribute to a decrease in yields of beets and sugar. (See Production proposal "Weed Control")

b. Insects, Diseases, and Nematodes

(1) Insect Investigations

ENT-ARS

(a) Beet Leafhopper - A series of experiments were carried on during 1954 in southern Idaho on the direct control of the beet leafhopper on curly top-resistant varieties of sugar beets (cooperation with FC) In these experiments, low-gallonage sprays containing DDT were applied at the rate of 1-1/2 or 3 pounds per acre, per application, when the plants were in the seedling stage. The pre-treatment examination of the plots revealed an average of only 1.8 beet leafhoppers per plant, a population which is apparently too low to significantly decrease the yield of varieties of sugar beets highly resistant to curly top. Yield records showed no significant differences between the sprayed as compared to the check plots. It will be necessary to repeat these experiments under conditions where there is a severe exposure of the sugar beets to curly top disease before the effectiveness of insecticide treatments can be reliably evaluated.

Laboratory tests with 30 insecticides against the beet leafhopper in southern Idaho showed DDT (90° C. setting point); DDT in a micronized form; CS-645A; and CS-6744 (Commercial Solvents Co. products) worthy of further testing under field conditions.

(b) Sugar-Beet Root Maggot - A survey of the territory in southern Idaho where the sugar-beet root maggot ordinarily causes severe damage to seedling sugar beets demonstrated that seed treatments with aldrin, dieldrin or heptachlor applied by the growers were effective in controlling this pest.

(c) Yellow-Striped Armyworm - Laboratory tests were conducted in southern Idaho to determine the relative toxicity of 10 organic insecticide spray formulations against the yellow-striped armyworm. The best results were obtained with sprays containing DDT, dieldrin, or endrin. Lindane sprays gave the quickest and most immediate effect against the armyworms but many of the treated insects ultimately recovered. Less effective results were obtained with sprays containing aldrin, heptachlor, toxaphene, parathion, and malathion. Sporadic infestations of this pest cause considerable damage to sugar beets in the western states.

(d) Beet Leafhopper Parasites - Nearly 120,000 egg parasites of the beet leafhopper, consisting of three species, were bred from material originating in Europe and released in the leafhopper -- infested districts of Idaho, Utah, Arizona, and California. Periodic and systematic collections of host eggs will be made to determine whether or not these beneficial insects have become established as natural enemies of the pest. This work was carried on in cooperation with the California Agricultural Experiment Station. Collections of adult beet leafhoppers in southern Idaho during 1954 showed that approximately 11 percent of these insects were being destroyed by a parasite known as "the big-headed fly." Similar studies during the period 1941-1954 showed that from 7 to 35 percent of the adult leafhoppers were being killed by this parasite, the average being 18 percent. (See Production proposals "Systemic Insecticides" "Southern Breeding Areas of the Beet Leafhopper," and "Biological Control of Insect Pests.")

(e) Beet-Leafhopper Surveys - Surveys in southern Idaho showed that the lowest population of the leafhoppers recorded during the last 6 years entered the winter of 1953-54. The winter was very favorable for leafhopper survival. During late April and early May the spring host plants were generally abundant and widely distributed in the burned-over and otherwise disturbed breeding areas

of the insect but these plants were dwarfed and sparse in the sagebrush areas owing to deficient precipitation. In general, these host plant stands were unfavorable for producing a threatening leafhopper population except for relatively small patches within and adjoining the cultivated areas and in a few desert breeding areas. Unseasonable, warm, dry weather during May caused the drying and premature maturity of many weed host plants, leading to the destruction of many leafhoppers. Laboratory tests indicated that an average of about 15 percent of the surviving leafhoppers were carrying the curly top virus which is considered to be about that of an average year. The leafhoppers began to move from their wild host breeding areas to sugar beets and other susceptible crops about 3 days earlier than usual and were much less abundant than during an average year. Surveys in the sugar beet fields of Idaho and adjacent eastern Oregon during August showed that about 13 percent of the plants were infected with the curly top disease, which is about twice the percentage of infection found during 1953 but below that of most years. These surveys will be continued in 1955.

Surveys early in the year in southern Utah, southern Nevada, southeastern California and in Arizona showed that the overwintering population of the beet leafhopper was only about one-tenth as large as for the corresponding period in 1953 and much below the average of the preceding 13 years. Similar surveys in northern and eastern Utah showed that leafhopper populations in these northern breeding areas were also very low. The leafhoppers from the southern breeding areas started to move northward into the cultivated areas during the second week in May which is about the usual time for this movement. At that time, about 4 percent of the leafhoppers were carrying the curly top virus as compared to an average of about 10 percent in preceding years. Surveys in the sugar beet fields of Utah and adjacent Colorado during the summer showed that the percentage of plants infected with curly top disease was relatively low in northern, central, or southern Utah, not exceeding 12 percent infection, but was moderate in western Colorado where about 40 percent of the plants were infected by curly top disease. It is planned to continue these surveys in 1955.

Two statements were issued to the sugar beet and cannery industries of Idaho, Utah, Colorado, and Nevada giving a timely summary of the beet leafhopper conditions, as revealed by the surveys. These enabled the growers of sugar beets and other susceptible crops to adjust their planting schedule and cultural practices to escape severe curly top infection.

In view of the beet leafhopper outbreak that occurred in western Kansas during 1953, a survey was made in February and March 1954 of the areas in southern New Mexico and southwestern Texas which were believed to be the source from which the insect spreads northward to western Kansas. The survey disclosed the absence of beet leafhopper host plants in the above area, caused by the prolonged drought, and indicated that only very few beet leafhoppers could have been produced in this area during 1953. The survey showed further that the occurrence of relatively warm winters during recent years has had the effect of extending the beet leafhopper breeding area into the high plains region of New Mexico, Oklahoma, and Texas, consisting of territory farther north and east than that which had previously been recorded as a potential breeding area. This phenomenon is illustrated by the finding of large leafhopper nymphs as far north as western Oklahoma in February. A low population of the leafhopper was found over a wide area and the host plants were sparse and widely distributed. This survey of the beet leafhopper and curly-top situation in the southern Great Plains and adjacent areas was resumed in mid-July. A comparatively low and widely distributed summer population of the beet leafhopper was found throughout the area. Curly top disease was common on sugar beets, garden beets, mangels, peppers, Swiss chard and tomatoes wherever these plants were grown. The curly top infection was more abundant on the southern Great Plains than in the areas further north and east and was observed as far east as Lawrence, Kansas. These surveys will be continued in 1955.

(2) Disease Investigations ...

FC-ARS

(a) Black Root - The question whether biological strains exist with Aphano-mycetes cochlioides, the pathogen chiefly concerned in black root, has been studied in cooperation with the Minnesota Agricultural Experiment Station. Twenty-five single zoospore isolates of the fungus from several localities and from several other hosts besides sugar beets were compared on three sugar beet varieties as differential host plants of the inoculation tests. All isolates were pathogenic to sugar beet but some were more virulent than others. Obviously, the black root resistance breeding program must continue its comparative tests under many environments to prevent the resistant varieties from appearing to break down when, in fact, a new and more virulent type of the pathogen has been encountered.

Methods of creating localized field epidemics of black root, by adding inoculum to the soil, were tested. In the selection work, it is highly important that disease exposure be severe. Pure cultures of A. cochlioides were contrasted with effects obtainable by adding soil known to carry the organism. A sterile beet-seed-vermiculite medium was inoculated with pure cultures of the black root organism and (a) was drilled in row before planting or (b) was broadcast and disked into the soil. Plots so inoculated gave stands that were, respectively, 38 and 62 percent of the check. Infested soil drilled in the row before planting gave a stand that was 62 percent of the check. The results, confirming earlier greenhouse investigations with pure cultures, indicate that an efficient method of assuring severe field exposures to A. cochlioides may be devised, the drilling of the inoculum in the row apparently being a promising method for increasing exposure to black root.

(b) Basic Studies on Curly Top Virus - Curly top, almost negligible as a factor in California for the last few years, showed a far greater incidence in 1954. In coastal areas, late-planted fields of moderately resistant varieties that were exposed to flights of beet leafhopper from the San Joaquin Valley suffered severe damage. From northern and eastern Colorado, western Nebraska, and western Kansas came reports of considerable losses from curly top. Previous to 1953 the disease was of minor importance east of the Rocky Mountains, with affected plants occurring only here and there in fields. From an isolated case reported in 1953, curly top was found in 1954 on many farms in southern Minnesota. The affected plants were relatively few; no indication of crop reduction was reported. The outbreaks of curly top in districts east of the normal distribution area of the beet leafhopper are not as yet interpreted as evidence that curly top has changed its type. There may be some indication that the vector is overwintering outside its normal range. (See Entomology report.) No conclusion is being drawn that the disease is on the move. Nevertheless, survey of the curly top situation is continuing in the tension areas.

Laboratory investigations have centered on chromatographic methods as a means of comparing the amino acid spectra of healthy plants and of those affected with curly top. The amino acids in the sugar beet leaves are changed as a result of the disease. The most striking change is in the amino acid tentatively identified as argenine. In one comparative test, this amino acid was found to be present in the expressed juice from curly top affected plants in approximately 10-fold greater concentration than in the juice from leaves of the healthy control plants.

The spot made by this amino acid with the unidirectional chromatographic technique employed is so much greater than the comparative spot from juice from healthy plants that curly top affected plants can be readily identified. In applying the new chromatographic technique to resistant and susceptible varieties of sugar beets, all plants being uninfected, their amino acid patterns are found to be significantly different. The most striking difference is the presence of an amino acid having an RF value near to that of cystine. This amino acid gave a much denser spot with tests of phloem exudate from two resistant sugar beet varieties than the spot obtained with phloem exudate of a susceptible variety. The spot was absent in the papergram from exudate from healthy mangel-wurzel roots.

(c) Virus Yellows - Investigations at the U. S. Agricultural Research Station, Salinas, California, show that virus yellows is transmitted in the field chiefly by the green peach aphid (Myzus persicae), but four other aphids have been found that transmit the causal virus-- the black bean aphid (Aphis rumicis), the potato aphid (Macrosiphum solanifolii), the cotton aphid (A. gossypii), and the dodder aphid (A. cuscuti). Of the last four aphid species, only the black bean aphid is known to feed extensively on the sugar beet, although the potato aphid is a transient feeder.

It seems very evident that field infection is transmitted from sugar beet plants and from plants related to the sugar beet (mangel-wurzel, red garden beet, chard, spinach) that survive the winter or are growing in the period between sugar beet crops. Eradication of all beet plants and their close relatives in the period between harvest of one crop and planting of the next crop might, in local areas at least, greatly reduce the amount of infection in commercial sugar beet fields.

There is clear indication that sugar beet yellows virus exists as a number of strains varying in virulence and other characteristics. They vary in their effects on sugar beet under greenhouse conditions from strains that cause very slight yellowing of older leaves to those that cause marked vein-clearing of younger leaves, splotching of half-grown leaves, and yellowing and necrosis of older leaves accompanied by marked stunting of the plant.

Tests of 100 field plants collected chiefly from various California locations indicate that mild forms of the virus predominate under field conditions, vein-clearing strains have been obtained from only two sources.

It is noteworthy, however, that such virulent strains do exist in California sugar beet fields. Veinclearing has not, however, been observed as a symptom on naturally infected sugar beets in the field. This conforms with European experience. Field plots inoculated at Riverside in September 1953 with a veinclearing strain showed this symptom throughout the winter and the plants were markedly stunted. Appraisal of the various strains with respect to degree of injury has not been made, but evidence is available that one of the more virulent strains reduced plant weight in greenhouse tests as much as 38 percent.

Virus yellows and sugar beet mosaic are sometimes found in the same fields in California or Colorado; in other fields only virus yellows is found. Studies on the feeding habits of the green peach aphid and its ability to pick up and retain the virus explain many field situations. The green peach aphid picks up very little virus in the first 10 to 20 minutes of feeding on diseased sugar beet plants, but the virus content increases with the feeding time up to approximately 6 hours, after which additional time on diseased plants does not increase ability to transmit the disease. Aphids fully charged with virus (i.e., after at least 6 hours' feeding) produce infection with only a 5-minute feeding time, but chances of infection appear to increase with feeding time up to 1 hour, after which there is little evidence of increased efficiency in transmission with more prolonged feeding periods. The green peach aphid was found to retain the virus of yellows for 48 hours but lost it in 72 hours when feeding on an immune plant. The relationships between virus yellows and the green peach aphid are strikingly different from those between a beet mosaic virus and the same insect. The peach aphid is able to pick up beet mosaic virus in feeding times of less than 1 minute, transmitting more readily after a short-time feeding than after several hours on diseased plants. Aphids that carry mosaic virus accomplish transmission in very short feeding periods. They lose the mosaic virus when starved 2 hours or more, and in less than 2 hours when fed on an immune plant. These differences in aphid relations of the yellows and beet mosaic viruses explain differences in spread of the two diseases in commercial beet fields from source plants having both mosaic and yellows.

(d) Strains of the Beet Yellows Virus in the United States and Europe - In cooperation with virus yellows specialists in England, Netherlands, and France, attempt has been made to compare reactions to virus yellows of 24 of Deming's Inbreds and 3 of McFarlane's Inbreds, along

with two varieties considered susceptible and one variety considered resistant in tests conducted in 1952 and 1953 in the United States. The same seed lots that were sent to Europe were used in comparison plants at Fort Collins, Colorado, and Riverside, California.

As yet, data have been received only from England. The readings on severity of top symptoms in many cases contradict those made at Riverside and Fort Collins. Varieties considered highly susceptible at Fort Collins, for example, showed only moderate reduction of foliage size in the English tests and essentially no difference in root weight between healthy and inoculated plants. These results confirm the preliminary conclusions drawn from 1953 experiments, namely, that virus yellows strains prevalent in Europe may be different from those of the United States.

(e) Distribution of Virus Yellows - Virus yellows had been recorded as occurring in California, Colorado, Michigan, Utah, Washington, and Oregon. Specialists of the beet sugar industry also report the disease from Nebraska and Wyoming. Yellows is present in all the sugar beet-producing districts of California, with the exception of the Imperial Valley and the seed-producing districts of the Hemet Valley. The incidence of the disease with reference to time of planting and aphid infestations is being studied.

(f) Virus Yellows Reduces both Root Yield and Sucrose - The question of the damage that virus yellows produces received partial answer from the tests in 1952 and 1953. In 1952 at Salinas, Calif., one experiment showed no decrease in root yield but a depression of sucrose percentage by one unit; in the second experiment, there was a depression of yield of nearly 33-1/3 percent and of sucrose percentage of 1 numerical percent. Tests at Riverside, California, in 1953 showed a 30-percent reduction in sugar per acre as a result of virus yellows, but this loss was almost entirely due to reduction in tonnage. A more comprehensive experiment to appraise the damage done by virus yellows was conducted with US 75 in 1954 at Riverside, California. The data from the first sampling indicate that virus yellows had reduced root yield more than 30 percent and sucrose percentage by 1 numerical percent. Sugar production was reduced 37 percent. In an appraisal test in Colorado, yields of the inoculated plants were 12.6 percent below those not inoculated.

The tests in California and Colorado conducted with replicated plots prove conclusively that the yellows virus, when it attacks the sugar beet early in the season, is capable of causing grave reduction in sugar beet yields and quality.

(g) Native Plants are Reservoirs of New and Potentially Dangerous Plant Viruses - The early virus research conducted at the U. S. Sugar Plant Field Station, Riverside, Calif., showed that dodder (Cuscuta californica) growing on native plants harbors a new virus named "Dodder-Latent Mosaic Virus" capable of attacking and producing injury to sugar beets, tomato, muskmelon, and a number of other crop plants. New studies have been initiated to find the distribution of this virus as well as to determine if other viruses capable of infecting the sugar beet occur in our native plants. From 135 separate dodder collections, at least four apparently distinct virus diseases have been isolated.

The results of these studies give evidence that undescribed viruses lurk in native plants of desert areas of southern California, and obviously elsewhere, that are potential dangers to our crop plants.

This basic information being developed on virus yellows disease should assist any program directed toward a practical control, either by breeding or other methods.

(h) Keeping Quality in Harvested Sugar Beets - Mechanization of harvesting operations is bringing fresher beets to the storage pile, but in many cases this advantage is offset by the greater quantities of leaves, trash, and dirt with certain types of harvesting. Because harvesting and storage processes are being better controlled, and because steps are taken to give proper ventilation and handling to storage piles, the spoilage of beets is now no more than half of what used to occur. Obviously, spoilage by micro-organisms, when it does occur, causes massive loss. Attempts in the cooperative tests conducted in Colorado to improve keeping quality of sugar beets by breeding storage rot resistant types are showing progress. Twenty-nine progenies of roots from a leaf spot-black root resistant variety related to US 400, which had been selected in the spring of 1953 for resistance to storage rot organisms--particularly to Botrytis cinerea attack, were given a field test for yield and quality in 1954. Storage rot comparisons are under way by means of inoculations using the agar culture method recently developed. If storage rot tests show that outstanding keeping quality has been achieved, the appraisal tests will furnish basis for selecting candidates for commercial production. On the other hand, if the degree of resistance to rotting is relatively low, indicating that additional selections are necessary, the material from the experimental field can be used as a breeding stock, and recently devised inoculation methods can be used to give an additional severe screening.

Another source of loss in beets in storage is that which comes through excessive respiration. As recognized, anything that can reduce beet temperatures also reduces respiration rate. Artificial ventilation of storage piles with chill night air serves to reduce beet temperatures. The breeding of low respiring beets is another possibility. Polyploid beets have been found to respire less than diploid beets of similar genetic constitutions, but again there are large differences among different beet strains. Apparatus has been devised to measure respiration rates from individual beets and from 20-beet samples. Respiration measurements by individual beets became a standard procedure in extensive evaluation of inbred lines of 1954 at the ARS Field Station, Salt Lake City, Utah. The problem involves basic investigations on sugar beet metabolism. Cooperative work with the University of Utah is providing facilities whereby respiration measurements may be made on small pieces of tissue to find out which portion of the sugar beet contributed most to respiration. Studies of virus enzyme inhibitors in relation to metabolic activity are in progress.

(3) Nematode Investigations

FC-ARS

(a) Breeding for Sugar Beet Nematode Resistance Starts - The sugar beet nematode is a serious pest in many of the major sugar beet producing areas in the United States and a potential threat to all areas. Chemical control has proved only partially effective in some soils and is an expensive means of combating the pest in those soils in which it is temporarily effective. All of our present varieties are extremely susceptible.

A new project aimed at the development of breeding stocks and varieties resistant to sugar beet nematode was started in 1954. To facilitate this work, a new greenhouse complete with headhouse was constructed at Salinas, California. Progress was made in the development of a technique for evaluating sugar beet plants for nematode resistance in the greenhouse. In order to provide a constant supply of nematode cysts which are needed in great quantity in the greenhouse work, a motor-driven soil shaker was designed and built. Through the use of this shaker, it is possible to concentrate the nematode cysts into a relatively small amount of soil which can be readily used in the greenhouse program.

A group of plants which showed apparent tolerance to nematodes in a severely infested commercial field were selected for possible use in the breeding program. (See Production proposal "New Measures for Nematode Control")

c. Breeding and Testing

FC-ARS

(1) Advances in Genetics Research - Physiological genetic studies in cooperation with the Colorado Agricultural Experiment Station have been started with several hybrids conforming either to yield or high sucrose types; in the summer of 1954 these were interbred in all combinations. In field plantings of roots most of these hybridizations were successfully made, but in a few cases because root supply was limited and the flowering of the inbreds was not synchronous, seed must be obtained by greenhouse cultures in the ensuing winter--the first stage in the comprehensive population genetics study of commercial varieties and inbreds will shortly be completed with the taking by individual plants of root weight, sucrose percentage, apparent purity, sodium, and raffinose data from a randomized complete block experiment with 80 blocks. During the summer, data on height of plant, spread of foliage, and on vigor were taken--study of polyploids and a program of increasing numerous inbreds believed to carry desirable breeding characteristics have been started--the purposes of the genetics research are manifold. Population genetics studies with sugar beets will be made on the original material and the different cycles of the reciprocal recurrent selection program. The research should provide a source of material extremely valuable to plant breeders in which the gene frequencies of the genes conditioning the more important agronomic characters are known. Further, this material will be included in studies involving the utilization through polyploidy of heterosis. Also, the value to a breeding program of cytoplasmic male sterility, self sterility, and near self sterility genes can be studied.

The screening for curly top resistance conducted at Salt Lake City, Utah, and Twin Falls, Idaho, in cooperation with the Beet Sugar Development Foundation, as applied to genetic material at Jerome, Idaho, in 1954 was one of the best on record. Here a mass of material from many different sources was evaluated for curly top resistance, including monogerm types, hybrids of the sugar beet with cultivated beets, etc. The new nonbolting varieties developed at Salinas, California, made a fine showing. Also, a series of polycross lines from SP 54104-0 selected at Beltsville, Maryland, and State College, New Mexico, for both leaf spot and curly top resistance made a fine showing under the severe curly top exposure. Hybrid combinations including several new monogerm hybrids exhibited their respective degrees of curly top resistance so clearly that little question remained regarding the disease resistance of each entry.

Methods for producing hybrid monogerm beet seed by utilization of almost complete male sterility in one partner of the cross

has experienced what might be termed a "windfall." Propagation of multigerm male sterile stocks has required very careful indexing to maintain the relatively rare type "O" lines which produce complete male sterility with "S" cytoplasm. Much research is necessary but indications are that this prolonged and expensive indexing program may be cut in half by use of monogerm lines in which the type "O" condition is more readily achieved and maintained.

Hybrid sugar beets are now being produced commercially on a limited scale. Preliminary yield trials of these hybrids indicate they outyield standard varieties much the same as hybrid corn outperforms the old open-pollinated types. To produce these sugar beet hybrids, non-pollen-producing strains are used as the female parent. This failure to produce pollen is brought about by male-sterile cytoplasm. This cytoplasmic male sterility has a rather complicated inheritance, involving different degrees of pollen development which can be determined by the color of the anthers. "Yellow anther" classes, indicating some pollen development, may or may not be fertile, while "white anther" means complete sterility. Breeders are working toward strains with the white anther character and a number of these are now available for use in making hybrids. Most of the investigations on inheritance are being carried forward in Utah and Michigan. Recent results indicate three genetic factors may be involved in inheritance of this character. A complete genetic analysis of this situation will facilitate hybrid sugar beet seed production.

A principal objective in the leaf spot resistance breeding work is the discovery of type "O" strains in leaf-spot-resistant monogerm material. In work cooperative with the Colorado Agricultural Experiment Station, over 2,000 hybrid seedlings representing approximately 90 parent matings (male-sterile ♀ X monogerm pollen-fertile ♂) were near the flowering stage in the greenhouse in November and will be ready for classification for anther type by January 15, 1955. These plants were obtained from seed harvested in the Ft. Collins, Colorado, greenhouse in June 1954 and were given a 10-week photothermal induction treatment ending September 30. By proper manipulation of cold and light induction, as previously discovered at this station, at least a year has been saved in obtaining these sugar beet generations. Field-grown roots representing each hybrid population, as well as roots representing the selfed progeny of each monogerm plant used as a male parent, are now in cold storage pending the outcome of the anther classification job. In addition, approximately 2,400 F₁ roots were saved from 85 crosses of a male-sterile X inbred lines. These roots will be planted in 1955 for check of the anther type to find type "O" inbreds. This is one of the most important steps in the breeding program because once the type "O" inbred is found from this test, the breeder can resort to the seed stock of this inbred for a dependable source of type "O" germ plasm.

(2) New Sources of Genes and Interspecific Hybridization - Forty-three new accessions of Beta maritima received this past year from various European sources have been grown in field plots under severe leaf spot exposure. A few of the new accessions were fairly resistant but none was more resistant than the accessions received from previous collections. Hybridizations (B. vulgaris x B. maritima and reciprocals) have now been made and the F_2 generation will be tested in 1955.

For several years, attempts have been made to cross sugar beets and Beta trigyna. Using tetraploid sugar beets as the pollen parent and mating with B. trigyna ($2n = 36$) has given four F_1 plants. Three of these have been brought to seed production and a progeny of over 20 seedlings are now growing in the greenhouse.

Viable hybrids between Swiss chard and Beta procumbens and B. webbiana were obtained in cooperative work at the Colorado Agricultural Experiment Station. The F_1 plants grown from seed taken from the chard mother were readily identifiable. Small hybrid seedlings were transplanted to pots filled with soil that had been heavily infested with sugar beet nematode cysts. At the same time, chard, sugar beet and B. procumbens seedlings were transplanted to pots similarly infested with nematode cysts. After several months of growth, the roots of these plants were washed free from soil. It was found that sugar beet and chard roots showed abundant sugar beet nematode infestation whereas the B. procumbens plants and the chard x B. procumbens hybrids were free from female nematodes. Although the number of plants available was limited, the differences were so sharp as to suggest strongly that the B. procumbens type of reaction to sugar beet nematode is dominant.

(3) US 104 Combines Resistance to Both Leaf Spot and Curly Top - As reported, SP 52104-0, obtained by crossing highly resistant curly top strains with leaf-spot-resistant strains, shows on the one hand a leaf spot resistance about equivalent to US 226 and a curly top resistance equal to that of US 22/3 or somewhat superior. Outbreak of curly top in eastern Colorado and western Nebraska brought about the revival of evaluation tests to find whether currently available material would be useful in the affected areas, or whether the breeding job must continue a longer period before making a release. Two seed stocks were available for test in 1954. These have much the same general genetic background and are designated as SP 5352-0 and SP 53104-0. In tests sponsored by the Beet Sugar Development Foundation, root yield and sucrose evaluations were made at Fort Collins and Sugar City, Colorado; Garden City and Selkirk, Kansas; Richfield, Utah; and Hereford, Texas. Plantings were made at Jerome, Idaho, and State College,

New Mexico for curly top readings, and at Fort Collins, Colorado, and Plant Industry Station for leaf spot readings. The evaluation tests and the observation tests dealt with several other varieties having more or less curly top and/or leaf spot resistance, but US 22/3, as the curly-top-resistant check, and SP 5352-0 and SP 53104-0 were the only varieties showing high curly top resistance. The field test at Hereford, Texas, was conducted under severe curly top exposure as indicated by a yield of only 0.32 tons per acre by a leaf spot resistant variety which had not been bred for curly top resistance. The curly top resistant varieties SP 5352-0, SP 53104-0 and US 22/3 yielded 23.49, 22.75, and 20.01 tons per acre, respectively. SP 5352-0 and SP 53104-0 have moderate to good leaf spot resistance as well as curly top resistance as indicated by root yields. For these two varieties definite progress has been made in combining resistance to both curly top and leaf spot. The varieties were reasonably productive under conditions where neither curly top nor leaf spot were factors, equalling in these tests the curly top resistant variety US 22/3 or the leaf spot resistant hybrid SP 521601-01 included as checks. The local variety where diseases were not a factor showed apparently greater adaptation and was superior in sugar production. It seems that definite benefit would come from utilization of a variety that combines resistance to both diseases in areas in which either or both of these diseases may strike. Use of the regular curly top resistant varieties are precluded because of their great susceptibility to leaf spot. By the same token, use of the highly leaf spot resistant varieties are precluded because of their susceptibility to curly top. Whereas the leaf spot resistance of the strains in question is not so high as can be achieved, the curly top resistance is apparently adequate for the exposures. Reselection for leaf spot resistance in the leaf spot-curly top resistant strains at Plant Industry Station, Beltsville, Maryland, has given a seed production designated as SP 54104-0. It has been supplied to the Beet Sugar Development Foundation for preliminary seed increase by the West Coast Beet Seed Company, Salem, Oregon. The variety will be officially released as US 104.

(4) Virus Yellows Resistance Breeding - As reported, two nonbolting, curly top resistant strains, NB 2502 and NB 2504, as bred by McFarlane at the ARS Field Station, Salinas, California, and US 201 B, as bred at Plant Industry Station, Beltsville, Maryland, have shown indications of resistance to virus yellows. Each takes the disease but, judging from top reaction and root size, the effect of yellows on these varieties is not so great as other varieties.

Virus yellows resistant inbreds from England and Holland showed, when tested at Fort Collins, Colorado, in 1953,

a range of virus yellows resistance as judged by top reaction comparable to what is exhibited by American sugar beet strains and varieties. The large collection of inbreds developed by Deming in cooperation with the Colorado Agricultural Experiment Station form a large array whose foliage reaction to virus yellows ranges from essentially no reaction to extreme susceptibility. These strains may be important sources of resistance. Extensive tests to establish the nature of virus yellows inheritance are in progress, cooperative with the Colorado Agricultural Experiment Station and the Beet Sugar Development Foundation. (See Production Proposal "Virus Disease Control in Sugar Crops")

(5) High Curly Top Resistance is Compatible with High Sucrose - An intensive program has been under way for a few years at the ARS Field Station at Salt Lake City, Utah, to improve sucrose content of sugar beets without loss of curly top resistance. That the two characteristics can be combined was demonstrated beyond any doubt in 1954. The most striking demonstration came by way of inbred lines. A Collection of 75 new lines rigidly selected for both high sucrose percentage and curly top resistance was tested by different locations. At Jerome, Idaho, under a severe exposure, nearly all showed high curly top resistance. At Salt Lake City, many were high in sucrose percentage and a few were extremely high. One line ranked next to the top in sucrose percentage at Salt Lake City and was rated highest of all in curly top resistance at Jerome. IBM machines have facilitated the analysis of the numerous measurements taken on 20 to 40 individual beets from each line. Weights and measurements of both roots and foliage were recorded. Petiole samples from each beet were measured and weighed, then dried for a study cooperative with the University of California on nitrogen in relation to sucrose percentage. Laboratory determinations were made of total solids, sucrose, sodium, potassium, nitrogen, and rate of respiration. The IBM machines automatically tabulated all of these data and made proper calculations at the same time. Sodium content proved to be one of the most interesting determinations. Some lines, usually the extremely high sugar lines, ran as low as 80 ppm of sodium, whereas other lines analyzed around 800 ppm. This tenfold difference was made still more significant by the striking uniformity of beets within lines showing that inbreds were not only distinctively uniform in appearance but may be remarkably uniform in chemical constitution. The choicest lines were saved at the final harvest in November.

This collection of inbred lines was developed by introducing a special gene for self-fertility with the original parentage. For maintenance of the line this high degree of self-fertility has great advantages but results in loss of vigor. However, by means of cytoplasmic male sterility, it is possible to utilize self-fertile lines for the production of vigorous commercial hybrids.

Among new inbred lines, some have been selected for Mendelian male sterility, i.e. they carry a gene for abortion of pollen and the male sterile recessives appear in ratio of 25 or 50 percent, depending on the type of inbreeding. These male sterile segregates make possible a convergent improvement program where one highly self-fertile inbred can be readily hybridized with another and the good characters of both incorporated into a new, superior sugar beet.

Hybrid varieties will shortly be used widely in the curly top area. In the sugar beet seed growing district at St. George, Utah, the entire seed crop for 1955 harvest will consist of hybrid seed. The curly top resistant inbred CT-9, developed at the Salt Lake City station, has been used as a parental component for most of these hybrids.

A group of eight new hybrids involving combinations between carefully selected self-fertile and self-sterile strains were tested by the ARS Field Station in Salinas, California, and by sugar companies at four locations in California. The performance of these new hybrids was encouraging, particularly in two tests in the central valley (Dixon and Tracy, California). In each of these two tests, the best-yielding hybrids produced 15 to 20 percent more sugar per acre than did the commercial variety (either US 56/2 or US 75) used as check. The hybrids were produced through the use of cytoplasmic male sterility, and the more promising combinations can be increased commercially if subsequent tests demonstrate that this is desirable. It is noteworthy that all are nonbolting selections.

(6) Resistance to Black Root

FC-ARS

As stated, in breeding for resistance to Aphanomyces cochlioides, important pathogen producing black root, it is recognized that the sugar beet variety required for the humid area needs to be leaf spot resistant as well.

The breeding program extends to Michigan and Minnesota Agricultural Experiment Stations from the Plant Industry Station, Beltsville, Maryland, since conditions at Beltsville permit severe leaf spot and moderate black root exposures to be given in the same field. In 1954, the investigations were expanded over those of 1953. A total of seven triple-lattice field experiments were conducted, each consisting of 36 seed entries--three of which were checks: US 400 commercial, 1953 production; US 400 commercial, 1952 production; and 53AB3-0, a reselection for black root resistance from US 400. The remainder of the entries in each experiment were polycross seed lots arising from black root resistance selections in Michigan and Minnesota and from leaf spot-black

root resistance selections made at the Plant Industry Station. Two of the seven experiments were planted late in June to evaluate, the same year, seed lots obtained from greenhouse productions in Michigan and Beltsville.

Approximately 25 percent of the polycross seed lots were rated as superior to US 400 in leaf spot resistance and, also, in seedling stand, seedling vigor, and plant vigor which, collectively, indicate black root resistance. Mother roots (1 or 2) were selected from each plot of polycrosses outstanding in both leaf spot and black root resistance. The remainder of the plot (one row, 20 ft. long) was taken as sucrose sample. Root weights were obtained from all plots. As one would expect, polycrosses outstanding in both leaf spot and black root resistance were, with few exceptions, the high yielding ones. In addition to high root yield characteristics of the leaf spot-black root resistant polycrosses, eight out of thirty-two gave sucrose percentages significantly above that of US 400.

The mother plant of each polycross outstanding in leaf spot and black root resistance and high in sugar has been continued in culture as a clone or as a selfed progeny. These have been planted in the greenhouse for seed production as a source of new inbred lines in a recurrent selection program and as breeding material which can be used to synthesize new leaf spot-black root resistant varieties.

In six early planted triple-lattice experiments of 36 seed entries (6 repl.) conducted on the Plant Industry Station, a reselection from US 400, designated 53AB3-0, occurred as an entry along with US 400. In each, 53AB3-0 gave a higher root yield than US 400 and the average of all six experiments gave over 17 percent gain for the reselection.

(7) Tests of US 400

FC-ARS

Results of the evaluation tests of leaf spot-black root resistant varieties, conducted in Michigan and Ohio in 1954, are available. Planting and thinning periods were, in most areas, wetter than desirable, followed by a very dry mid-season period and then an extremely wet harvest time. All-time rainfall records were exceeded in many areas during October. Harvest of the beet crop was accomplished under extreme difficulties, whereas root yields will probably be at or near a record high point in most districts. Sucrose percentages are expected to be extremely low, ranging from 7 to 9 percent sucrose on muck land and from 11 to 16 percent on uplands.

Although the 1954 season was not favorable for production of a maximum commercial crop, the conditions at several of the sites where the evaluation tests were located made it possible to demonstrate the superior qualities of the leaf spot-black root resistant varieties. US 400 and the reselection from it (SP 53AB3-0) are of particular interest. In 18 replicated tests (8 X 8 Latin-square design), US 400 exceeded in root yield the commercial check variety US 216 X 226 in all except three of the tests. Black root was particularly severe at St. Louis, Michigan, and Fremont, Ohio. Here the yields of US 400 were, respectively, 32 and 12 percent greater than the yields of the check variety.

Of particular interest is the performance of SP 53AB3-0, the reselection of US 400. It out-yielded its parent, US 400, in seven of the nine tests in which the two varieties occurred together. In five tests, the differences were undoubtedly significant and in the other tests, performances were about equal. These results with the reselection, reinforced by the critical evaluation given at Beltsville, indicate that the steps under way to release the reselection as a successor to US 400 are warranted.

Seventeen thousand two hundred and thirteen pounds of US 400 seed were produced in 1953, and an estimated production of 360,000 pounds of seed--enough to plant the 30,000 acres most subject to black root and leaf spot--are available for the 1955 plantings.

(8) Progress with Monogerm Sugar Beets

FC-ARS

Several acres of curly top resistant monogerm hybrid sugar beets were grown for seed in 1954. Abundant seed will be available for thorough spring mechanization studies in 1955. There have been significant improvements in monogerm stocks, including larger size of seed. A new monogerm line, SLC 91, did especially well. A seed isolation (1/2 acre) was grown in cooperation with the Beet Sugar Development Foundation. SLC 91 is more vigorous, flowers earlier, and is more resistant to curly top than previous releases. Male-sterile monogerm beets were grown in strips adjacent to SLC 91 pollinator. Seed stocks from the SLC 91 pollinator and also from the MS lines were immediately distributed to interested beet sugar companies and a very much larger acreage for seed has been planted for seed harvest in 1955.

d. Machinery Investigations

AE-ARS

At the present time it appears that some type of mechanical random stand reducer-weeder is one of the most effective tools for reducing the labor requirements for thinning and weeding sugar beets. A tractor-mounted power-take-off driven, double-counter rotating spring tine stand reducer-weeder with a variable speed drive has been successfully used to reduce by 50 percent the labor requirements for thinning and weeding sugar beets. Three different manufacturers have built pilot models of thinners utilizing features combined and tested in the experimental machine. Another manufacturer is building counter-rotating head units for attachment to his conventional machines.

Tests of various types of press wheels and furrow openers combined with downward forces on the press wheels have produced differences in average emergence rates which were significant statistically. However, the practical value of the results is limited by the non-uniform and unpredictable emergence rates. It appears the problems of planting, emergence and uniform stands, without thinning, could be satisfactorily solved (at least greatly improved) with the development of a monogerm seed with proper vigor and yield characteristics. Until such a seed is developed it is rather difficult to improve the present method of planting an excess of seed in the row and thinning to the desired stand. Weed control in the row and thinning to the desired stand. Weed control in the row and removal of excess beet plants are thus closely related with this method of planting.

Plans for the Future - Work on sugar beet machinery by the Agricultural Engineering Research Branch in cooperation with the Michigan Agricultural Experiment Station has been closed out for the present. The former project leader is still available at another location for continuing consultation with industry and other interested groups regarding the machinery investigations. If favorable development continues on monogerm seed it is possible that the machinery phases of the work will be revived.

2. SUGARCANE

a. Production and Management

(1) Cultural Practices

FC-ARS

Experiments designed to study soil aeration, factors influencing it, and its effect upon nutrition and growth of sugarcane were initiated at Houma in compliance with the 1954 recommendations of the Sugar Advisory Committee. Light soils, including Commerce and light phases of Mhoon, and heavy soils, including Sharkey and heavy phases of Mhoon, are being studied. A comparison of cultivated and virgin soils shows that sugarcane cropping caused a decrease in organic matter, and

cultivation practices increased the mass density of the soil. This increase in mass density indicates that artificial compaction has occurred just below the plow depth in field soils. These findings open the way for further studies designed to determine the extent and significance of the compaction factor.

In tests at Brewton, Alabama, yields of sirup per acre from plots of fall-planted sugarcane were equal to those from spring-planted plots. Fall planting results in a saving of labor for planting, by eliminating the banking of seed cane, and a reduction in damage to seed cane, caused by disease organisms, during the winter months. These advantages favor the use of fall planting of sugarcane in Alabama.

Tests have been initiated at Meridian and Poplarville, Mississippi, to determine the effect of different depths of planting the seed cane on yields of cane and sirup per acre in plant cane and stubble crops. Three depths of planting have been used in these tests: 1-1/2 inches, 3 inches, and 4-1/2 inches. Preliminary yield data from these tests will be available in 1955.

(2) Fertilizers

FC-ARS

A review of data from nitrogen fertilizer experiments conducted in Louisiana over a period of years indicated a high variety x fertilizer interaction. Based on this information, rates of nitrogen treatments were superimposed, during 1954, on five variety tests throughout the "Sugar Belt." In addition to the broader application and usefulness of the fertilizer information obtained for the several varieties tested, this procedure will reduce the cost of outfield work by using one area of land and the same labor for securing variety and fertilizer information. This saving will make it possible to devote more time to fundamental soils and fertilizer studies such as the soil aeration studies described above.

Potash has repeatedly given significant increases in yields of cane and sirup per acre in Georgia. Tests were initiated, during 1954, in Georgia and Mississippi to determine the effect of different sources of potash on yield and quality of sirup. Further tests on different soil types, different varieties and growth conditions, including plant cane and the accumulative effects in stubble crops, are needed to adequately evaluate the different sources of potash.

(3) Weed Control

FC-ARS

For the past several years, various herbicides have been tested in limited exploratory tests (in cooperation with the

Weed Control Section) to determine their effectiveness for controlling weeds in sugarcane at Meridian and Poplarville. Based on these preliminary tests, the most promising herbicide is CMU. While CMU is less effective in years of normal rainfall than during dry seasons, the results are sufficiently promising to indicate the important need for additional experimental work. It is important that this new research on weed control in sugarcane give special emphasis to the southwide problem of controlling Johnson grass. In this connection it is also important to determine whether there is a harmful residue effect from the herbicides in the sirup, sugar, and by-products produced. (See Production proposal "Weed Control")

b. Insects and Diseases

(1) Insect Investigations

ENT-ARS

(a) Soil Pests - Good progress was made on the insecticidal control of soil arthropods attacking sugarcane. In heavy Louisiana soils an increase of 7.3 tons of cane per acre was obtained by using 5 lbs. chlordane per acre applied to the seed pieces in the open furrow at planting time. Applications of endrin, toxaphene, isodrin, DDT, BHC, dieldrin, and parathion increased yields from 3.1 to 6.9 tons per acre. This work will be continued.

(b) Sugarcane Borer - Research work on the control of the sugarcane borer by the development of resistant varieties, use of insecticides, cultural practices and by biological methods has been continued. One sugarcane variety, 48-363, showed a marked degree of resistance to the sugarcane borer and is being used by plant breeders in their breeding program. A few other varieties also have shown good resistance. Strobane gave better control of the sugarcane borer in the 1954 tests than aldrin, toxaphene, dieldrin, parathion, heptachlor, or chlordane. A mechanical shredding attachment on cane harvesters for destroying sugarcane borers in cane tops gave promise of materially reducing overwintering populations. Additional releases were made of two larval parasites of the sugarcane borer received from Trinidad. Preliminary examinations showed a substantial initial establishment of these species from previous releases. These investigations will be continued. (See Production Proposals "Sugarcane Borer Control" and "Biological Control of Insect Pests")

(c) Insect Vectors of Sugarcane Diseases - Research work has been initiated to determine if soil arthropods are responsible for the transmission of ratoon stunting disease of sugarcane. These investigations will be continued.

The work on sugarcane insects was conducted in cooperation with the Field Crops Research Branch and the Florida and Louisiana Agricultural Experiment Stations. (See Production proposal "Insect Vectors of Plant Diseases")

(2) Disease Investigations

FC-ARS

(a) Deterioration Studies - The ratoon stunting disease, considered to have an important part in the deterioration of commercial varieties of sugarcane, caused heavy losses in Louisiana and Puerto Rico. (These studies were recommended in the 1954 report of the Sugar Advisory Committee). In a small replicated experiment at Houma, yield of first-year stubble cane of C.P. 44-101 was reduced 22 percent in plots of diseased as compared with healthy cane. Higher losses were reported for P.R. 905 in Puerto Rico.

Lack of a reliable method of identifying the presence of the virus of the stunting disease in sugarcane plants is a handicap in research work related to that disease. Paper chromatographic techniques are now being tested in a search for a suitable method for identifying the presence of the virus. Gross symptoms, useful for identifying the disease in field plantings, are not critical enough for experimental work.

Inoculated and uninoculated plots of cane grown from hot-water treated seed cane are being compared with field-run (diseased) cane in germination, growth, and development of gross symptoms. This study includes 60 commercial and parent varieties at Houma, 50 parent varieties at Canal Point, and 4 commercial varieties at Meridian.

Since the commercial and parent varieties are not resistant to this disease, it is extremely important to determine how to most efficiently control the disease by artificial means. The American Sugar Cane League has undertaken, in cooperation with pathologists at Houma and at the Louisiana State Agricultural Experiment Station, Baton Rouge, the job of applying the hot-air treatment (54°C for 8 hours) to small-scale seed lots of some of the commercial varieties. This treated seed cane is to be planted on the increase stations in an attempt to build up limited supplies of disease-free seed cane. It is recognized that this procedure can, at best, take care of only a small fraction of the immediate needs of the industry. In experiments at Houma, longer hot-water treatments at lower temperatures are being studied in comparison with the present procedure (Minimum of 50°C for 2 hours) to determine whether effective, less hazardous hot-water treatments may be used.

Severe stunting of C.P. 29-116 at Poplarville, Miss., indicates that the ratoon stunting disease may be present in that part of the sirup area. Tests of treated and untreated seed cane have been planted to determine the presence of the disease.

The widespread prevalence of this disease and its striking ability to depress yields of cane and sugar per acre emphasize the need to continue extensive studies relative to an accurate technique for identifying the presence of the virus in the plants and methods of control by artificial means and by developing resistant varieties.

(b) Other Disease Studies - The nature of resistance in sugarcane to *Pythium* root rot and the parasitism of the fungus are being studied in accordance with information furnished in last year's report. Also, studies are being continued with *Sclerospora* in a special effort to learn more about the disease and means of transmitting it to sugarcane and other grass hosts.

(c) Chlorotic Streak - Studies related to this disease in Puerto Rico indicate that the symptoms on Merker grass are very similar to those on sugarcane. In a test at Lagjas, yields of Merker grass in diseased plots ranged from 25 to 50 percent less than in healthy plots - somewhat higher than in sugarcane. Transmission studies are needed to determine the relationship between the chlorotic streak diseases of Merker grass and of sugarcane.

c. Breeding (See Production Proposal "Physiological and Genetic Research on Sugar Plants")

(1) Resistance to Mosaic

FC-ARS

The search for superior mosaic-resistant varieties of sugarcane, during 1954, involved the largest number of seedlings ever handled in our breeding program at Houma during any one year. From 100,000 seedlings, 7,820 mosaic-free seedlings were set in the field at the Houma Station. These involved 119 crosses, 40 percent of which were recommended for repetition by the cooperating agencies and the remainder were from exploratory crosses in a search for new, useful combinations. The Hawaiian system of bunch planting was tried for the first time to determine the feasibility of using that method under Louisiana conditions. In Florida, 24,500 seedlings were grown at Canal Point and at the Everglades Experiment Station, Belle Glade, Fla. Of these seedlings, 2,500 were from seed produced by the Hawaiian Sugar Planters Association. In the sirup area, 10,000 seedlings from 36 crosses were tested for mosaic; of these 3,310 mosaic-free seedlings were grown at Meridian, and 3,647 at Cairo, Ga. In Puerto Rico, 50,000

seedlings were grown in cooperation with the Puerto Rico Agricultural Experiment Station, as compared to about 6,000 in 1953. The combined search for mosaic-resistant varieties of sugarcane involved 162,277 seedlings from crosses designed to produce varieties that also possess high sugar content, high yielding ability, resistance to lodging, and agronomic characteristics adaptable for machine harvesting.

Varietal improvement through breeding requires vigilant attention to the job of continuously increasing our storehouse of scientific knowledge about the parent varieties, their behavior, and the characteristics of progenies from various crosses. Cytological studies conducted at Beltsville, in cooperation with the Hawaiian Sugar Planters Association during the year included 253 clones of Saccharum officinarum, S. sinense, S. spontaneum; numerous interspecific hybrids; several commercial varieties; and related species to furnish basic information for the breeding program. In accordance with 1953 recommendations of the Sugar Advisory Committee, physiological studies designed to evaluate environmental factors such as the influence of photoperiod, quality of light, night temperatures, mineral nutrition, and chemical growth regulators on floral initiation (or inhibition) were conducted in Hawaii in cooperation with the Hawaiian Sugar Planters Association. The first results of these studies will be available after the tests have been harvested - sometime during the period January to March 1955. Breeding techniques now used at Canal Point are being directed toward a careful consideration of temperatures, light, and other growth factors in an effort to increase the efficiency and the scope of the breeding program and to produce an abundant supply of viable seed from the desired crosses.

(2) A New Variety for Louisiana

FC-ARS

N. Co. 310 was released to growers in Louisiana during 1954, based on its performance in numerous variety tests throughout the "Sugar Belt." The results indicate that this variety is adapted to light and heavy soils. It shades the land early in the season, is satisfactory in cold tolerance, and produces yields equal to, or higher than, the two principal commercial varieties, C.P. 36-105 and C.P. 44-101. It is recommended for all areas of the "Sugar Belt" except where mosaic-infected Co. 290 is still grown.

(3) Other Promising Varieties

FC-ARS

Based on limited tests, C.P. 50-28 is a promising variety for the Fellsmere, Fla., area, where it produced much higher yields of sugar per acre than the standard commercial variety, C.P. 34-79.

Also, this variety has cold tolerance, medium fiber content, and high sucrose. In Louisiana, C.P. 48-103 produced a higher yield of sugar early in the season than any of the commercial varieties. Its erect type of growth makes it well adapted for machine harvesting. However, it does not shade the land well during the growing season.

(4) Deterioration of Harvested Cane

FC-ARS

Co. 281 has been considered, for many years, as an adequate standard for checking the rate of inversion of sucrose in new varieties. Six selections from the cross F.36-819 x C.P. 48-126 ('53 C.P. series) were, in tests at Houma, equal to or slightly superior to Co. 281 in resistance to inversion. In addition, the six selections are rated, by entomologists, as above the average in resistance to the borer. While the agronomic value of these selections remains to be determined, the results indicate that this cross is promising to give resistance to sucrose inversion and possibly also for borer resistance. This study should be continued and expanded to include other crosses and all promising selections.

(5) World Collection

FC-ARS

Importation of about 60 varieties of sugarcane possessing high sucrose and other desirable characters from Australia, Barbados, Colombia, Formosa, Hawaii, Puerto Rico, and other countries increased substantially our supply of available breeding material. Cuttings of varieties now growing in our world collection were sent to 10 countries: Australia, Belgian Congo, Bolivia, Colombia, Formosa, Madagascar, South Africa, Spain, Uruguay, and Venezuela. This reciprocity arrangement makes it possible for us to receive annually the best available varieties of sugarcane throughout the world.

Varieties received during 1954 are now growing in the quarantine greenhouse at Beltsville. 150 varieties imported during previous years were planted in the recently established secondary quarantine station, located at the Plantation Field Laboratory near Fort Lauderdale, Fla., operated in cooperation with the Florida Agricultural Experiment Station. An International Committee is working on the problem of finding means and a place for a World Collection, but no definite progress can be reported.

d. Machinery Investigations

AE-ARS

The capacity of the U.S.D.A. experimental sugarcane harvester was increased by replacing the conventional sugarcane carts with special large 5- to 6-ton four-wheel wagons. The use of these wagons reduced the number of transfers and the time required to make each transfer. A transfer from a loaded to an unloaded wagon (formerly requiring 3 to 5 minutes) was accomplished in less than 30 seconds with the present method.

The use of a winch on the harvester for pulling the sugarcane wagons made it possible to attach or detach the wagons without positioning the harvester with respect to the wagon for connecting a ball and socket or pin-type hitch. In addition to being easier to handle, the winch cable hook is much safer for the operators.

A harvesting rate of 25 tons per hour was obtained on many one-load tests. However, three wagons and two tractors did not provide sufficient hauling capacity for the harvester to be operated continuously. With this limited equipment an average rate of 9 tons per hour was maintained during one 6-hour test.

The capacity of the upper stripper is the primary limiting factor on the capacity of the U.S.D.A. harvester. It was found that a positive feed should be incorporated into this unit to provide for the uniform feeding of the canes.

The installation of a ground drive for the front gatherers provided a more uniform rate of feeding and eliminated stubble damage caused by the engine drive. The effectiveness and trash discharge of the lower strippers was improved by mounting the cylinders lower in the harvester frame.

A tractor-mounted sugarcane planter was designed, constructed, and tested during 1954, to cut the cane into the lengths desired, and to plant at the rates desired. The feed cylinders as constructed are capable of feeding trashy cane. During tests made in the fall of 1954, a 4.7-acre field was planted at the rate of 1-1/2 acres in 4-1/2 hours on the last day. All the cane was transferred by hand from the hauling wagons to the planter. With satisfactory mechanical loading a capacity of 4 to 6 acres per day is possible.

The cutting or shredding of tops of sugarcane plants is being investigated in cooperation with the Entomology Branch, as a possible practical method of reducing overwintering populations of the sugarcane borer. It is intended that the cutter or shredder be integrated into the harvester if it proves economically feasible.

Plans for the future - Studies will be continued at about the same level on the sugarcane machinery investigations with emphasis on the harvester, cane topping or shredding device, and planter.

3. SUGAR SORGHUM (SORGO)

FC-ARS

High yields of sugar per ton and per acre from sorgo have been depressed, during past years, by the ravaging effects of diseases. Available parent material in our world collection (approximately 3,000 varieties) has demonstrated resistance to the four major sorgo

diseases - red rot, leaf anthracnose, zonate leaf spot, and rust. Recent tests at Houma indicate that resistance to rust (one of the most severe sorgo diseases in the "Sugar Belt") is controlled by one genetic factor - a great aid in developing varieties suitable for sugar production in Louisiana. Similarly, several varieties have shown resistance to the other three diseases.

If available germ plasm can be successfully utilized in the practical solution of the basic factors involved in adapting sorgo for sugar production, it will make available a very valuable supplementary sugar crop - far exceeding its present established use for sirup and in other phases of American agriculture. The production of superior varieties of sorgo for sugar production will require careful research in evaluating parent varieties, determining the heritability of the major plant characters involved, in measuring through biochemical studies the influence of the carbohydrate, protein, and other components on the quality of the juice for sirup and sugar production, and in exploring the use of male sterility and polyploidy as useful tools in plant improvement. (See Production Proposal "Sorgo (Sorghum) Breeding")

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ENT-ARS

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B. PROPOSALS FOR COMMITTED CONSIDERATION
(Order of listing has no priority significance)

PRODUCTION RESEARCH

a. Radiation Techniques Applied to Sugar Crops

Initiate a comprehensive program to produce new varieties of sugar beets and sugarcane by radiation. Outstanding results have been obtained in some crops by the use of radiation, which has been supplied through the facilities of the Atomic Energy Commission, to produce new gene complexes. In peanuts, for example, radiation at the Brookhaven Laboratory provided germ plasma which in the second generation has resulted in increasing yields--35 percent in some strains over the standard variety from which the radiated seed came. To obtain these high yielding segregates, over sixty acres of plots had to be planted. It has also been found that changes due to radiation have resulted in providing segregates having greater disease resistance than the original, for example, Mohawk oats. Theoretically, radiation could also result in a concentration of the genes necessary for high sugar production in sugar beets and sugarcane. Such a program means a large amount of detail work but the results may justify such an effort. The potential value of this new tool in genetics and breeding is too important to be left unexplored. Such studies should be applied to both sugar beets and sugarcane.

b. Polyploidy to Improve Sugar Beet Yields

Initiate extensive research for producing polyploid sugar beets to increase their productivity. Sugar beets normally have 18 chromosomes. This diploid number can be doubled by proper treatment to produce plants with the tetraploid number, i.e., 36 chromosomes. Some of the European work on sugar beets and work on other crops indicate considerable promise for improvement by these methods. Using male sterility to produce hybrids, it would appear that crosses between high-combining tetraploid and diploid beets might provide high-yielding triploid beets for commercial production. This field should be thoroughly explored by developing a comprehensive program under such a project.

c. Physiological and Genetic Research on Sugar Plants

Increase efficiency of sugar beet and sugarcane breeding through basic research. Many urgent problems should be solved to provide a basis for the most effective progress in the varietal improvement programs. The inheritance and nature of disease resistance in sugar beets should be thoroughly studied to accelerate progress in breeding for resistance. The inheritance and behavior of important characters such as male sterility, etc., in the sugar beet should be more fully investigated in order to allow its most effective use in hybrids. Studies on combining ability and methods of breeding in sugar beets and cane would pay large dividends in the ultimate production of commercial hybrids. In sugarcane, further detailed studies on the physiology of flowering are needed to

enable plant breeders to obtain the type of crosses desired. A study of the physiology of cold and heat resistance, which may be correlated, would be advantageous in producing new varieties with greater cold resistance.

Basic studies on the relations of sugarcane varieties to insect resistance would be extremely useful in the practical breeding program. The studies indicated above are all of a fundamental nature which would provide the necessary tools and information for greater progress in the future. (See Production p. 26)

d. Virus Disease Control in Sugar Crops

Initiate new studies and expand present work to control virus diseases in sugar beets and sugarcane by breeding or other means. Virus yellows of sugar beets and ratoon stunting of sugarcane are both present in the United States and are causing serious reductions in yields. The possibility of more virulent forms of virus yellows developing suddenly, as apparently they have in Spain in the last two years, cannot be over-emphasized. Already it is known that there are more virulent forms now in existence in California than those found generally distributed in commercial fields. Appraisal tests indicate damage from the disease ranges from 12 to 30 percent in Colorado and California, respectively. Exhaustive efforts on control of this grave virus disease should therefore be made, including the breeding of adapted, resistant varieties.

Equally serious is the ratoon stunting virus disease of sugarcane which is widespread throughout the cane growing regions of the world. In recent tests on the standard variety C.P. 44-101 in Louisiana, a reduction of 22 percent was found in the yield of the first stubble crop, due to stunting disease. Higher losses have been reported for P.R. 905 in Puerto Rico. The enormous wastage from this disease demands immediate attention. Heat treatment of the seed cane offers possibility of alleviating loss from this disease, but this should not preclude a determined effort to produce resistant varieties. Moreover, the World Collection at Canal Point should be freed from the ratoon stunting disease. (See Production p. 17)

e. Quality Studies

Initiate studies on the inheritance of quality factors in sugarcane and sugar beets which together with studies on these factors in the laboratory would provide a sound basis for quality improvement in these crops. Relatively minor changes in the constituents of either sugar beet or sugarcane might greatly improve mill processing and thus enhance their value. This project will also provide material from basic genetic strains and other stocks for cooperative utilization studies.

f. New Measures for Nematode Control

Expand present studies on nematodes and initiate new work. Nematodes now represent one of the serious problems in both sugar beet and sugarcane culture. Studies should not only be made on the various types of nematodes

involved but also on practical measures for their control. Breeding for resistance to the sugar beet nematode should be pushed forward not only by means of selections within the sugar beet strains and varieties but also by hybridization between species, particularly using wild species of Beta which appear to be immune or near immune, and further by the radiation of sugar beet germ plasm, to determine if it is possible to obtain segregates which have resistance to nematode infection. The same types of studies should be applied to sugarcane. Nematode investigations that will permit full utilization of the gene resources are needed for both sugar beets and sugarcane. A start has barely been made on breeding sugar beets and sugarcane for nematode control, but the seriousness of the problem demands far more research. (See Production p. 13)

g. Weed Control

Expand studies to develop methods of economical weed control in sugar beets and sugarcane. The control of weeds in sugar beets and sugarcane is undoubtedly one of the most expensive items in sugar production. Progress is being made to obtain herbicides for control of weeds in both crops, but this research should be expanded. Studies should be made to evaluate new herbicides and combinations of existing herbicides for the pre-emergence weed control. Investigations should be made to provide satisfactory pre-emergence and post-emergence herbicides. New research on weed control in sugarcane is especially needed for the control of Johnson grass. (See Production pp. 3 & 23)

h. Sorgo (Sorghum) Breeding

Initiate studies to develop high sucrose, disease resistant varieties of sorgo. Recent tests at Houma indicate that new sorgo hybrids are resistant to rust and other sorgo diseases in Louisiana. If all the available breeding material and knowledge of varietal behavior can be brought to bear on the project, it appears possible to develop new varieties that will have a high sugar content, high-yielding ability, resistance to diseases and lodging, and that are valuable for sirup production.

In addition to the breeding program itself, there is an important need, in developing new varieties and in utilizing the crop, to conduct studies designed to supply information about the composition, heritability, and variability of the carbohydrate and other components of the plant and their influence on the quality of the juice for sirup production. Low, economical cost of production, adaptability to complete mechanization, range in climatic adaptability, and recent advances in varietal development work indicate the potential usefulness of sorgo as a supplementary cash crop. (See Production p. 29)

i. Systemic Insecticides

Expand work on systemic insecticides for use in the control of pests of sugar beets and sugarcane. (See Production p. 4)

j. Southern Breeding Areas of Beet Leafhopper

Expand studies of the beet leafhopper and its weed-hosts in areas of New Mexico and western Texas which serve as the source of infestations in Kansas, eastern Colorado, and adjacent areas. (See Production p. 4)

k. Sugarcane Borer Control

Expand work on sugarcane borer and lesser cornstalk borer resistance in sugarcane, including fundamental studies on the nature of resistance. (See Production p. 24)

l. Insect Vectors of Plant Diseases

Expand studies to determine the role of insects as vectors of diseases of virus, fungous, and bacterial origin affecting sugarcane and sugar beets. (See Production p. 24)

m. Biological Control of Insect Pests

Expand research to develop methods of utilizing parasites, predators and insect diseases for the control of insect pests of sugar beets and sugarcane. (See Production pp. 4 and 24)

II. UTILIZATION RESEARCH

A. PROGRESS ON WORK UNDER WAY

1. COMPOSITION AND QUALITY PRESERVATION

a. Composition of Sugar Beet Processing Liquors

WU-ARS

As a continuation of the work reported last year and in accordance with recommendations in the Advisory Committee's report transmitted under date of May 19, 1954 (Recommendation No. 1 under Utilization Research), comparative studies have been made at the Western Utilization Research Branch of the composition of diffusion juices from freshly harvested beets and similar juices from beets held for varying periods of time after harvest. This work was undertaken to determine the effect of delayed processing after harvesting upon sugar content and the presence of troublesome impurities.

Generally, diffusion juices from beets held after harvesting gave increases in amino, malic, and lactic acids. In some cases, beets from different localities also showed increases in raffinose and in a trisaccharide that may be kestose. These changes are indicative of anaerobic fermentation with a concomitant loss in sugar.

The work done to date is an essential forerunner to studies of the relative importance of the metabolism of sugar beet tissue and microbial activity on sugar beets, both of which cause losses of sugar before beets are processed. This work should be expanded.

Studies on the composition of normal diffusion juices have also been undertaken to determine, if possible, what constituents are indicative of the molasses forming tendencies of beet juices. It was found that the ratio of sucrose to nitrogen and the ratio of sucrose to the anionic constituents are related to molasses formation. Measurement of the total nitrogen and of total available acidity of limeed diffusion juices should enable prediction of the amount of molasses that will be formed. Plant breeders should be able to use these chemical tests in the development of new varieties of beets that will produce less molasses during processing for sugar. Additional work on the melassigenic properties of beets will depend upon investigations to be carried out in the sugar beet pilot processing unit and upon fundamental studies on the solubility and rate of crystallization of sucrose in the presence of various impurities. Therefore, no direct work on molasses formation from diffusion juice is contemplated for the coming year.

Methods have been developed for the separation of the purines and pyrimidines of diffusion juices. To date, uracil, xanthine, and hypoxanthine have been tentatively identified in diffusion juices and in quantities great enough that they will account for most of the hitherto unaccounted for nitrogen.

Continued work on the composition of processing liquors is planned.

b. Composition of Beet Molasses

WU-ARS

The work reported last year by the Western Utilization Research Branch has been continued with completion of more than 400 analyses of molasses samples from 13 different factories. Practically all of the amino acids (which with betaine constitute about 70% of the total nitrogen), 75% of the anionic and most of the cationic constituents have been accounted for. As indicated for the diffusion juices, some of the components of the purines and pyrimidines of molasses have been tentatively identified. They include adenine, uracil, guanine, and hypoxanthine and account for most of the previously unknown nitrogenous substances.

Of the anionic constituents isolated, over 90% of those in the diffusion juices have been identified, while in the molasses only 75% are known. It is believed that increased amounts of acids such as glyceric are produced from sucrose and invert sugar during the liming process and become a part of the molasses. This, of course, constitutes a source of sugar loss in processing. Quantitative estimates of the extent of these losses depend upon the development of methods for the determination of such acids.

When the pilot scale processing unit is complete and the actual process of molasses formation can be traced, additional studies will be undertaken.

c. Composition of Beet Pulp and Reexamination of the Sachs-Le Docte Method for the Determination of Sugar in California Beets

WU-ARS

The work reported last year by the Western Utilization Research Branch has been continued with special emphasis on the amount of pulp constituents in the extract used to measure sucrose content. This constitutes an expansion of the work on the Sachs-Le Docte method of sucrose determination and takes into consideration the effect of optically active impurities. The composition of the amino acid impurities is such that the levo- and dextro-rotatory effects about cancel each other. Some pulp constituents in the extract could cause the sucrose measurement to be slightly high. However, comparisons between direct total sugar determination and polarization values gave the same sucrose concentrations within the limits of the experimental error of the method.

Measurements of the volume of the insoluble residues of beets gave Sachs-Le Docte volume values near 177 ml.

During the course of this work, the marc (beet insoluble residues) content of 15 sugar beet varieties from the Crop Research Area and 64 varieties from the Beet Breeders' Forum were analyzed. A positive correlation was found between sucrose content and marc. Furthermore, the variation in the marc content, from 3 to 6 percent, is sufficient to cause variation of about 0.5 ml. in the Sachs-Le Docte volume.

The laboratories of the sugar companies operating in Northern and Central California completed 683 analyses of the Sachs-Le Docte volume and obtained an average value of 178.1 ml. About 100 more analyses have been obtained from the Imperial Valley during the 1954 Spring campaign which showed an average Sachs-Le Docte volume of 178.2 ml. It is concluded, therefore, that apparently differences in geographical areas in California are inconsequential.

It is expected that work on Sachs-Le Docte volumes as a means of measuring the sucrose content of sugar beets will be completed in the fall of 1954. Analysis of all the data should point up any corrective measures necessary for accurate determination of sucrose content of sugar beet. Additional studies of sugar beet pulp will be carried out by investigations of the soluble colloids and their harmful effects on extraction and purification of sugar.

d. Effect of Minor Constituents of Certain Refined Beet Sugars

WU-ARS

Investigation of the role of saponins in formation of floc in beet sugar solutions--a serious problem to the bottling industry--has been continued by the Western Utilization Research Branch. The saponin fraction has been separated into two different components designated as "fast" and "slow" components because of their rate of movement in an electric field. The two are present in the sugar beet in about equal amounts. The "fast" one is largely removed from the sugar during processing, hence is of no great concern. The "slow" one is not removed in present processing procedures, however, and remains as a contaminant in the final product.

Study of various sugar beet saponin mixtures have shown the carbohydrate portion to consist of glucuronic acid, xylose, and glucose in varying amounts. The non-carbohydrate or non-sugar part of the saponins is oleanolic acid and another unidentified, closely related acidic material.

Methods for saponin analysis have been developed and the information has been supplied to all sugar beet companies. At least two of the larger manufacturers are using the information to aid in their processing technology.

Study of saponins will be continued with the aim of developing methods of saponin elimination applicable to factory operations that will enable production of sugar that is acceptable to the bottling industry, which is the sugar industry's largest single consumer.

e. Relation of Processing Quality to Composition of Sugarcane

SU-ARS

Information is being obtained systematically on variations in the concentrations of nine non-nitrogenous organic acids in sugarcane juices of known processing quality. The juices represent a wide range of differences in composition and clarification characteristics as they are produced in the pilot plant experiments on evaluation of new sugarcane varieties for processing. Automatic fraction collecting equipment has been provided to facilitate analyses of lyophilized juice solids prepared from raw juices of six new varieties and of the widely-grown standard variety. Results of these analyses on samples obtained during the 1953 grinding season and again during 1954 will provide sufficient data to establish any significant relationship between concentrations of these metabolically important acids and the gross composition of juices in relation to clarification. Comparable chromatographic methods for systematic determination of concentrations of amino acids are being perfected so that the preserved juice solids can be analyzed for nitrogenous acid constituents also. This will reveal significant correlations between juice processing quality and the ratio of non-nitrogenous to nitrogenous acids.

Expansion of this research is essential to take advantage of the new analytical techniques applicable to available samples of juice solids for determining their composition more completely, including important plant constituents and metabolites such as starch and phosphatides. The potential value of such information to geneticists when it can be related reliably to agronomic qualities such as early maturation, disease resistance, and sugar producing capacity, is recognized by workers in both crops and utilization research to afford a most fruitful and necessary field of cooperative investigation. Plans have been formulated for study of changes in composition during growth and maturation of sugarcane, as well as the effect of stunting disease upon composition, that can be activated if funds are provided for an expanded program. (See Utilization Proposal "Correlation of Composition of Sugarcane and Cane Juice with Processing Quality")

f. Losses Resulting from Delayed Milling of Harvested Sugarcane

SU-ARS

Research was initiated under a contract with Louisiana State University to determine the effect upon milling quality of prolonged holding of cane in the fields prior to grinding. During the past season a series of experiments were carried out on a pilot plant scale by milling 2-ton samples taken from windrowed cane at intervals of from one day to about two weeks after the total sample was cut. Repetition of similar experiment next season will provide data on the quantitative deterioration in milling quality resulting from various periods of holding windrowed cane.

Juices obtained by milling the samples of cane that had been held in the field for successively longer times were clarified and processed in the pilot plant operated by SURB at the Audubon Sugar Factory. It was possible to integrate these experiments with the schedule of pilot plant tests of new sugarcane varieties.

The processing experiments will also be repeated during another grinding season and will be supplemented by information obtained on changes in composition of the juice caused by delay in milling that may be related to deterioration in its processing quality.

g. Home Preservation - Jellies with Added Pectin

HN-ARS

To obtain background information on pectin products sold for home use, jellies made according to various manufacturers' directions were prepared from strawberries, cherries, peaches, and bottled grape juice. The "set" of jellies made from liquid and powdered citrus and apple pectins ranged from 72 to 125 percent according to fluidmeter measurements whereas 80 to 100 percent generally represent the range for satisfactory consistency.

Natural fruit flavor was scored as weak to moderately weak in these jellies, and judges' comments suggest that the natural fruit flavor may have been masked by a flavor too sweet in many jellies, and by a flavor too acid in a few. The finished jellies made according to pectin manufacturers' directions ranged in acidity from pH of 2.80 to 3.52, practically the entire range possible for gel formation. The soluble solids in the finished jelly ranged from 60 to 67 percent, a range which is generally considered satisfactory. Formulas for homemade jelly using various commercial pectins are being developed.

It has been found that for each fruit satisfactory jellies can be made using one formula with all powdered pectins for household use on the market and a second formula with the liquid pectins. This also holds true for jams, which, however, require a different formula. Laboratory and home experiments with formulas adjusted for use with market units of commercial pectin and a 1-minute boiling period on jellied fruit products made from strawberries, blackberries, currants, cherries, plums, grapes, and peaches have been completed.

Tests on jellies made from canned grape juice with both liquid and powdered pectins gave no indication of change in firmness during storage up to 4 months. Peach, plum, and cherry jellies made from fresh fruit showed an increase in firmness after storage for 6 to 8 months. Tests are in progress to obtain more information concerning set of jellies upon storage for varying lengths of time.

Comparison of palatability judgments by an untrained panel of 40 and a trained panel of 5 people has given some useful information on flavor evaluation. To determine whether differences in flavor of fruit jellies made with varying proportions of sugar to juice could be discriminated by taste, jellies varying in the amount of natural fruit flavor present were made, using proportions ranging from equal amounts to twice as much sugar as juice but having 62 percent soluble solids in the finished jelly. These were taste-tested by 40 untrained persons. In a triangle test, twenty-six of the people could distinguish between two samples having the largest difference. More people preferred the smaller proportion of sugar when the choice was between samples made from large versus small proportions sugar to juice. When the choice was between the medium and small proportions of sugar to juice, a larger number of people preferred the medium proportion. A trained panel of 5 persons rated, for natural fruit flavor, jellies with the same high, medium, and low proportions of sugar to juice. On a 5-point scale, mean scores ranged from 2.8 to 3.1 showing that they could detect little difference in the amount of natural fruit flavor in these samples. The variation in results from the two panels may be due to the difference in the methods used for evaluating flavor. The triangle test indicates only whether there is any difference between samples; while the scoring method attempts to measure the degree of difference.

Problems experienced by the panel members in evaluating differences in flavor of jellies led to another experiment on methodology of taste-testing. Samples of jelly were prepared from concentrated frozen grape juice diluted with different amounts of water so that the jellies differed in amount of grape flavor. Samples were presented in various ways and in varying numbers per session, and rating was done by ranking and by scoring. The differences

among the samples were large enough that all members of the tasting panel could differentiate the samples by either the ranking or scoring method.

Plans for future: Data from all studies will be evaluated and prepared for publication.

Limited methodological studies as described will be continued until funds become available to undertake systemic research on improved methods of evaluation of palatability.

h. Survey of Food and Nutrition Research

HN & DU

To aid research leaders in universities, industry and government prevent duplication of effort, a survey on the nature and amount of food and nutrition research under way in this country during 1952-53 was completed under contract by the National Academy of Science. The report records research under way by some 440 organizations. It includes research in food, food technology, physiological and biochemical aspects of nutrition, nutrition in disease, the nutritive value of food and feed and nutritional requirements of man and beast. In the section of Food Technology, there are listed 42 projects dealing with sugars and sweets. Also included in the report are some 250 suggestions for research of immediate urgency.

Plans: This project has been completed.

2. HUMAN NUTRITION AND CONSUMPTION

a. Nutritional quality of per capita food supply

HN-ARS

As one indication of how well our national food supply provides for the nutritional needs of the population, the nutritive content of the per capita food supply is computed at least once a year, permitting analysis of the trends since 1909. A revision of this series recently published shows average values for calories, and 11 nutrients, as well as the proportion of each nutrient furnished by each of 12 food groups. In 1953, sugar and sirups were the third largest contributor of calories, accounting for 16 percent of the total as compared with 22 percent from grain products and 20 percent from fats and oils. Average values for several nutrients were somewhat lower in 1953 than in the peak years of 1945-56.

Plans - Computations of the nutritive value of the food supply will be continued at least yearly as a basis for studying trends.

b. Studies of Nutritional Requirements

HN-ARS

An intensive series of data on actual energy expenditure of children at different ages and activities, collected over the last 10 years is being summarized for publication. This will serve as a much needed guide to nutritionists for estimating the caloric needs of children.

Work has continued to determine the energy requirements of young women (20-30) and of older women (50-60) engaged in the same selected physical activities.

In an attempt to define minimum protein requirements, it was found that the type of carbohydrate in the diet also affected the level of amino acid required. Present work is comparing the effect of different starches, dextrins and sugars upon the protein requirements.

Plans - The preparation of publications on the energy expenditures of children and studies on the energy requirements of women and on the influence of carbohydrate on protein requirements will be continued.

3. DEVELOPMENT OF NEW AND IMPROVED PRODUCTS AND PROCESSES

a. Extraction of Sugar from Beets

WU-ARS

The work being carried out under contract by the University of Michigan has, as indicated in last year's report, been extended to include the design, fabrication and testing of an apparatus for continuous rupture of the cells of beet cossettes and thus aid in liberation of the sugar-rich beet juice.

In test operations, 99% sugar recovery was achieved with 130 draft (weight of water to weight of beets times 100). Centrifugation at 660 times gravity reduced pulp weight to 30% of the original beet weight.

Advantages suggested for the continuous rupture procedure are:

- (1) the apparatus may be cheaper and require less space than diffusers,
- (2) decreased fuel costs in the pulp dryer due to its low water content.

The disadvantages that would have to be overcome before the process could become economically attractive include: use of a draft higher than that in modern diffusers, necessity for recycling up to 1/3 of the cossettes which are not initially ruptured and which in turn reduces throughput capacity, use of high pressure steam, and the high gravitational forces necessary for producing low water content pulp.

This phase of the contract work has been completed. The approach undertaken in this study for improved extraction of sugar from beets does not, at this time, appear particularly promising. (See Utilization proposal "Increased Recovery of Sugar From Beets")

b. Continuous Counter-Current Diffuser

W U-ARS

The contract with the University of Michigan also includes the design, construction, and study of certain performance characteristics of a continuous, counter-current laboratory-scale diffuser for removal of sucrose from sugar beet cossettes. The design and construction work are completed. Investigation of certain operational variables and their relationship to subsequent processing operations will be undertaken in the near future.

c. Pilot Plant Sugar Beet Research

WU-ARS

The Sugar Beet Development Foundation has allocated \$45,000 for the purchase or fabrication of equipment for a pilot scale processing unit to be located at the Western Utilization Research Branch (Albany) for use by the Western Utilization Research Branch in studying the chemistry of various phases of sugar beet processing. Plans for the pilot plant are nearly complete and an area for its installation in the Laboratory has been designated. A pilot-scale limer and carbonator are being fabricated in the Western Utilization Research Branch shops. Bids have been let for the construction of the cells necessary for a "Roberts" diffusion battery, and bid specifications for a cossettecutter have been prepared.

As rapidly as possible the pilot-scale processing unit will be completed and test runs to establish performance characteristics will be made. When all equipment is operating satisfactorily, chemical studies will be initiated.

d. Determination of Sugar Beet Sample Size for Processing studies

WU-ARS

A contract has been negotiated with the Utah State Agricultural Experiment Station for determination of the variation of sucrose, amino acid-nitrogen, marc, glutamic acid, total nitrogen, total available acidity, oxalic acid and malic acid in individual sugar beets. This information is necessary in determining the proper sample size for pilot scale operations so that the results therefrom are meaningful.

This work is just getting under way.

e. Crystallization of Beet Sugar

WU-ARS

The contract work being done by the College of the Holy Cross, and reported in part last year, has been continued.

It has been demonstrated that the mechanism of crystallization is heterogeneous and that, in order to obtain reproducible results from ultrasonic irradiation, known amounts of seed sucrose crystals must be added to the system. Ultrasonic irradiation has improved the development of crystal seed formation, possibly by the formation of crystal nuclei.

Maximum crystal density was obtained at a power input of about 150 watts per sq. cm. of generating surface. Increased agitation by stirring gave some improvement in crystal density.

Holy Cross plans to study the effect of concentration, times of irradiation, and effect of agitation before expiration of the contract on May 5, 1955.

f. Determination of Processing Quality of New Varieties of Sugarcane

SU-ARS

The pilot plant experiments on clarification and processing of six new sugarcane varieties relative to the standard variety were continued with the cooperation of the American Sugar Cane League and the Louisiana State University Engineering Experiment Station. Results obtained during four previous seasons have established the limits of confidence with which these data may be used to predict performance of a new variety when released for commercial sugar production. Data obtained on variety No. Co. 310 were considered by the League in arriving at a decision to release this cane for planting 1954. Poor clarification characteristics established for unreleased variety C.P. 45-184 contributed to the decision to drop this variety from further agronomic testing on the secondary stations. Sugar boiling equipment was added to the pilot plant during the last season and operated to a limited extent, but funds and personnel available are still inadequate to study continuous filtration and to investigate improved clarification and processing procedures. There is still urgent need to expand this research so that it will include integrated experiments on the complete sugar recovery process on the pilot plant scale that has been perfected for the study of clarification. (See Utilization Proposal "Determination of Processing Quality")

f. Dependence of Raw Sugar Quality Upon the Presence of Starch in Sugarcane.

SU-ARS

Further investigation of the occurrence of starch in sugarcane and product derived from it have established the fact that this constituent is not responsible for difficulties in clarification, but that it does contribute to poor refining quality of raw sugars in which it is adsorbed during crystallization. Sirups and raw sugars were again analyzed for starch with the cooperation of the industry, who furnished composite samples of these materials. The starch contents of all of the juices used in the pilot plant processing experiments on different varieties of cane were also determined during the 1954 grinding season. Representative samples of whole cane, mixed juice, and bagasse were obtained from 2-ton samples ground in the Audubon Factory experimental mill and analyzed to determine the distribution of starch in products of the grinding operation. Continuation of this research and expansion to include investigation of other complex organic nonsugars will be necessary to discover all of the factors contributing to variations in refining quality, and to devise practical means of eliminating the most deleterious impurities so that average refining quality may be improved. (See Utilization Proposal "Refining Quality of Raw Sugar")

g. Impurities Causing Floc in Refined Cane Sugar Sirups.

SU-ARS

Research of limited scope, employing analytical methods, was begun with the cooperation of a large sugar refiner near New Orleans to supply floc-free and floc-forming lots of sugar from which the impurity responsible for its separation in bottling sirups can be isolated. This work will be correlated closely with the broader investigation of impurities contributing to poor refining quality in raw sugars. Methods must be devised to accumulate a sufficient quantity of the impurity that separates from acidified sugar sirups before the substance can be characterized. Intensive investigations of this impurity to determine its chemical nature, exact composition, and origin, as well as to devise practical means of eliminating it at either the raw sugar or refining step of the process, will require additional funds. (See Utilization proposal "Floc Formation")

h. Production of Direct Consumption Sugar by Ion Exchange Purification

SU-ARS

More extensive and systematic experiments on a small pilot plant scale were carried out during the last grinding season on the use of ion-exchange to purify clarified juice for production of direct consumption sugar.

This work concentrated upon determining optimum cycles and operating conditions, using the best exchange resins available in a sequence of anioncation-anion exchange units selected on the basis of previous comparative tests of a variety of these materials. The third exchange unit was selected to remove color as well as to neutralize the effluent of the cation exchanger. Indicated costs are such that this process would be economical if used after standard clarification to produce a direct consumption grade of sugar that can be marketed similarly to turbinado sugar.

Larger scale development research will be necessary to establish accurate investment, chemical, and operating costs for this process as well as to establish the grade specification for the direct consumption sugar of which sufficient quantities can be produced to explore the market for it in specialized uses such as candy manufacture. (See Utilization Proposal "Direct Consumption Ion-Exchange Sugar")

j. Expanded Uses of Sugar in Confectionery.

SU-ARS

Research has been initiated on a study of the optimum grades of sugar for economic production of different types of candy, using both the ion-exchange sugar referred to above, and turbinado sugars. It is possible to conduct this work, recommended with a priority No. 7 in the last report of the Sugar Advisory Committee, without additional funds because it is coordinated with the research on pilot plant processing of sugarcane and that conducted on confectionery in cooperation with the National Confectioners' Association. The market for sugar in confectionery can be expanded by widening the use of turbinado sugars for more types of candies for which these are suitable, and the grade of sugar obtained by ion-exchange purification can be used in making almost all types of candy, including those that cannot be produced with turbinadoes. (See Utilization Proposal "Sugar in Confectionery")

k. Dextran-Blood-Plasma Extender

NU-ARS

Although the demand for dextran diminished with the cessation of the Korean hostilities, the Armed Services have continued to purchase this product both for stockpiling and for current needs to supplement the supply of blood plasma. An increase in use of dextran in civilian medicine has been reported, particularly in those regions not readily accessible to blood banks. As reported previously, domestic companies producing clinical dextran continued to use the dextra-producing organism, Leuconostoc mesenteroides NRRL B-512, discovered at the Northern Branch and the production methods developed there.

Work on dextran during the past year has been devoted to completion of the details of the new enzymatic process whereby dextran of the correct molecular size for clinical use is produced directly in high yield from sugar solution. Pilot-plant runs confirmed laboratory results showing that yields nearly double those of the conventional process could be obtained. Need for less equipment adds to the economies of the new process.

Other researches on dextrans have been concerned with the determination of their detailed molecular structure by chemical and physical methods. All dextrans have been found, for example, to have branched molecules, yet the extent of branching and the chemical linkages at the branch points differed widely among the approximately 100 different dextrans examined. Similarly, the length of the branches varied with the dextran. Such structural knowledge is necessary in the interpretation of the diverse allergenic and immunological properties of dextrans and, thus, to the safe and successful use of dextran as a plasma substitute. Progress also was made during the past year in understanding the mechanism whereby the enzymatic synthesis of dextran occurs, adding to our knowledge of methods for conversion of simple sugars to high molecular weight polysaccharides. Such information is fundamental to the microbiological conversion of sugars derived from cereal grains into polymeric substances of potential value such as gums, thickening agents, textile sizes, and similar applications. Experimental work on the various phases of the dextran project has been terminated. There remains only the summarization for publication of the phases most recently completed.

1. Organic Acids from Molasses

NU-ARS

(1) Fumaric Acid - Studies have been initiated to improve the production of fumaric acid by submerged mold fermentation. Experiments are being directed toward the development of information which can be applied to the fermentation of inverted cane and beet molasses. The objective is to provide more economical processes for the production of fumaric acid. Around 7 million pounds of fumaric acid are expected to be produced in 1954. Of this amount, about one-half is expected to be produced through fermentation of cane molasses. Increasing demands for fumaric acid for the production of synthetic resins and the upgrading of drying oils and varnishes bid fair to make fumaric acid a product of increasing importance.

(2) Citric Acid - The laboratory experiments on the submerged fermentation of molasses for the production of citric acid were completed last year, and the project on fumaric acid was initiated to take its place. Recently an industrial firm has become interested in conducting pilot-plant trials of our citric acid process. Plans are now under way for giving aid and advice to this firm for the evaluation of our process.

m. Culture Collection

NU-ARS

Many of the most significant uses for the sugars, starches, and other carbohydrates of farm commodities have been developed through the use of fermentation procedures. The successful prosecution of a broad program of research in fermentation is dependent upon the availability of a large and diverse collection of microorganisms. Cultures of microorganisms constitute the agents or tools employed to effect important and valuable transformations of sugars and starch.

The culture-collection project of this Branch has been in operation since 1940, with emphasis on the collection, classification, and investigation of microorganisms potentially capable of producing useful products. It contains molds, yeasts, bacteria, and actinomycetes used for the production of products such as antibiotics, vitamins, blood plasma expander, acids, and proteins. The Culture Collection furnishes service as follows: (1) Supplies pure cultures, many of which are industrially important, to academic, agricultural, and industrial research investigators; (2) operates a bank for depositing industrially important microorganisms including those connected with patents; (3) provides material for identification and comparison and (4) furnishes the above services to this and the other branches of the Agricultural Research Service. Within the last year, 232 cultures were added. Microorganisms from the Collection, in addition to regular use in the investigations at this Branch, were sent to many other investigators in Government, universities, and private industry. One thousand eight hundred and forty-eight cultures were furnished last year to various groups outside the laboratory engaged in agricultural research.

This work will be continued on the current scale.

n. Home and Institutional Food Preparation

HN-ARS

Two publications off the press in the series, Recipes for Quantity Service, contain 13 recipes containing sugar as one of the major ingredients. These publications are distributed to restaurants, cafeterias, hotels, nursing homes, hospitals, and other institutions to encourage use of plentiful foods by providing appealing recipes which are clear, concise, and simple to use.

Plans - These projects have been discontinued and there are no plans for further studies.

4. UTILIZATION OF BYPRODUCTS AND DISPOSAL OF WASTES

a. Separation of Bagasse into Pith and Fiber

NU-ARS

An analysis has been made of the large mass of engineering and operating data accumulated in a 2-year study of processes industrially applicable for separating bagasse into fiber with

but little pith and pith essentially free from fiber. Cost studies indicate that it will be more economical and practical to process fresh bagasse at the sugar mill than to process stored bagasse. A report of the investigation is being prepared in bulletin form.

Work under contract with the United States Sugar Corporation on carrying out a large-scale commercial trial of the Northern Branch's method of separating sugarcane bagasse into high-grade pith and fiber, baling the fiber, and making pellets from a mixture of 25 percent pith and 75 percent molasses, was undertaken in April 1954, at which time the weather in Florida is generally very favorable. Extremely dirty cane came into the mill as a result of extended severe rains. The unfavorable condition of the bagasse produced pith so highly contaminated with dirt that its absorption capacity was too low for use. After two or three attempts had been made to operate, the work had to be postponed until the next grinding season which will probably start sometime late in 1954. However, enough work was done to establish the fact that the disc-mill method for loosening the pith from the fiber is practical. It was determined that some water will have to be added to the bagasse coming from the sugar mill at 50 percent moisture content in order to soften the pith sufficiently so that the pith content of the fiber can be lowered to about 3 to 5 percent. The special screens which were designed for the separation of pith and fiber after drying proved to be practical and operated satisfactorily.

b. Bagasse Pith as an Absorbent for Molasses and Other Feedstuffs

NU-ARS

Under a cooperative agreement with industry, studies have been completed to develop a satisfactory method for mixing pith from sugarcane bagasse with blackstrap molasses and pelleting the mixtures into forms suitable for shipping and for handling by commercial feed manufacturers. Satisfactory pellets were prepared from a mixture of 30 parts pith and 70 parts blackstrap molasses having a Brix of 72.5⁰. A conventional pelleting mill had an acceptable capacity after installation of a force-feed mechanism to reduce the bulk of the mixture. Agricultural experiment stations in the Northern, Eastern, and Southern regions were informed of this pelleting study and of the proposed production, under the research contract with the United States Sugar Corporation, of approximately 125 tons of pellets for experimental purposes. Samples of pellets were also furnished a number of the stations for examination and experimental use. Eight agricultural experiment stations from the Northern region, five from the Eastern region, and six from the Southern region have requested a total of 150-200 tons of these pellets for special feeding tests during the fiscal year 1955.

The effects of additions of distillers' solubles, proteins, vitamins, minerals, and animal fats to bagasse pith on its absorptive properties is being studied. (See Utilization proposal "Improved Outlets for Bagasse")

c. Pulp and Paper from Bagasse

NU-ARS

Fundamental pulping studies on sugarcane bagasse, using the mechano-chemical method have been continued. These studies have clarified a number of the factors which contribute to the most favorable pulping conditions. Because bagasse generally contains more lignin than does straw, it requires more cooking chemical. With the optimum amount of chemical to produce a satisfactory pulp from bagasse, the lignin content of such pulp was generally somewhat higher than that of a comparable straw pulp. Because of the higher lignin content, the bagasse generally requires more chlorine or other bleaching agent than is required for a comparably cooked straw pulp to produce pulp with the same degree of brightness. Increasing the chemical used in cooking the bagasse results in pulp with a somewhat lower lignin content but may bring other disadvantages such as higher costs and more chemical hydration of the fiber. Mechano-chemical pulping studies on bagasse are being continued to clarify some of these points.

Interest in, as well as publicity on, the use of sugarcane bagasse for pulp, paper, and board products appears to be increasing in this country, in spite of the fact that domestically only a relatively small amount of bagasse could be made available for this purpose.

A pulp mill has been built in Louisiana for the daily production of approximately 50 tons of bleached bagasse pulp, ostensibly for newsprint. This plant started production early in the summer of 1954.

In connection with the Point IV operations of FOA in Formosa, the Northern Branch has carried out some pulping work on bagasse obtained from that island. This work was done on behalf of the Government Taiwan Pulp and Paper Corporation of Formosa with the assistance of an employee of the company sent to this Branch as a trainee for this work. The results showed that this Formosan bagasse behaved much like Louisiana and Puerto Rican bagasse samples available at the Branch. Satisfactory pulps could be made from the depithed Formosan bagasse with 15 percent caustic or kraft chemicals (based on dry bagasse) in 1 hour in a Hydrapulper at 95° to 98° C. This information was relayed to the Taiwan Pulp and Paper Corporation through a report of their trainee. It is expected that at least a part of the bagasse pulping operations in Formosa using the neutral sulfite process will be converted to the Branch's mechano-chemical process.

Continuing practical shipping tests using the corrugated boxes produced experimentally from bagasse pulp at the New York State College of Forestry under a contract in 1953, Libby, McNeill, and Libby of Chicago, Illinois, shipped by rail canned pear juice in experimental boxboard containers from their warehouse at Hammond, Indiana, to another warehouse in Pittsburgh, Pennsylvania. The

containers with the canned juice were removed from the car, stored temporarily in the warehouse, and reshipped by truck to Hammond where these containers with some of their own carrying the same juice as controls were examined. The experimental containers survived this brief shipping test at least as well as the commercial boxboard containers regularly used by the company for this purpose. The results of this test corroborate those of a previous shipping test by the Pabst Brewing Company.

Under a research contract with the New York State College of Forestry, Syracuse, New York, bagasse depithed at the Peoria Laboratory was pulped by the mechano-chemical process in a commercial Hydrapulper and the unbleached pulp was bleached under a subcontract by the St. Regis Paper Company in Deferiet, New York. Owing to an unfortunate accident at Deferiet when the bulk of the bleached bagasse pulp was diverted into a large storage chest containing wood pulps, the bleached bagasse pulp remaining was sufficient for making only one machine run and newsprint was chosen for the run.

No difficulties in pulping, pulp processing, bleaching, or paper-making were encountered that could not be easily overcome by slight modification or redesign of some of the mechanical equipment involved in these operations.

The New York State College of Forestry reports that the experimental work carried out under this contract demonstrated that newsprint could be manufactured using bleached mechano-chemical pulp from bagasse and groundwood pulps which would match the sheet characteristics of commercial newsprint. Samples of this paper were furnished the Government Printing Office and the results indicate that it met fairly well the Government standards for the specified grade. Work on the preparation of pulps for fine papers for specialty purposes from bagasse will be continued.

Under a cooperative arrangement with a large company in the rayon business, a study has been made of methods for the preparation of dissolving pulps for rayon manufacture from bagasse. This study has involved a step-by-step fundamental investigation of means for prehydrolyzing bagasse to remove pentosans, followed by cooking and a 7-stage bleaching operation. It has been possible to prepare dissolving pulps containing 96 percent or more of alpha-cellulose, 2 percent pentosans, and less than 0.1 percent ash, of a brightness of 91 and a degree of polymerization of about 700. These pulps, whose analytical values compare favorably with those of hardwood rayon tire-cord pulps, are being studied for their suitability by filtration and spinning trials. One of the earlier pulps was spun into rayon thread of rather low quality. It is believed that the pulps developed more recently should be of superior quality. This work which is being continued has disclosed considerable information concerning agricultural residue pulps not hitherto available.

The Northern Utilization Research Branch has believed that the proper place in industry for pulps from bagasse and cereal straws is in the manufacture of the highest type of papers or boards where the pulps may be used as blends with other pulps to produce products of a higher quality than hitherto manufactured. Repeated tests and now industrial runs have indicated that this thesis is correct and it is being accepted rather widely by industry. In order to follow up this problem of blending and to develop specialty pulps having properties of hardness, softness, transparency, opacity, and others, a midget paper machine has been acquired which is capable of producing a continuous sheet of paper 8 inches wide. It is believed that studies with this paper machine will greatly enhance the development work under way and will open up still more fertile fields to interest industry in the use of these waste raw materials. This work is being continued. (See Utilization proposal "Improved Outlets for Bagasse")

d. Development of Feed Additives from Beet Sugar Molasses WU-ARS

Work on the development of microbiological processes for industrial production of antibiotic supplements to increase the efficiency of poultry and swine feeding is in progress at the Western Utilization Research Branch. The initial phases of this work, involving the selection of a small group of the most promising antibiotic-producing bacterial strains from approximately 2,000 different cultures, through preliminary culturing trials and chick feeding tests, have been completed.

Culturing of the antibiotic-producing bacteria involves the use of molasses or other sugar-rich materials in the media, fortified with ammonium nitrogen and inorganic salts. The culturing process is rapid, requiring only 6 to 12 hours for completion.

Two types of nutritionally desirable factors have been found in connection with this work. One type includes antibiotics that give growth responses similar to those of commercially-available feed antibiotics. A new antibiotic, discovered at the Western Utilization Research Branch and which has been named "Aterrimin," is of this type. This antibiotic is of special interest because it promises to have a higher specific potency than penicillin G, the most active feed antibiotic known at present. It has proved active in tests in many different laboratories and its isolation and process development are well advanced.

With respect to the second type of growth factor, a number of the bacterial strains gave chick-growth stimulations that could not be related to antibiotics known to be present. It appears likely that some of these act through their content of vitamin-like factors. For example, on certain rations containing antibiotics, further stimulations in the growth of chicks are obtained.

The outlook for producing inexpensive feed supplements from the selected bacterial strains appears good. The culturing process, because of the short time required, offers inherent advantages with respect to minimization of pure culture precautions that must be exercised with fermentations of longer duration, and should also be readily adaptable to continuous operation with minimal capital investment. Recovery costs of the active factors are also expected to be relatively low since the bacterial cells have been shown to be readily recoverable in centrifugal yeast separators. This eliminates the cost of drying the greater part of the culture wherein the desired factors are associated naturally or can be caused to precipitate with the bacterial cells such as by acidification of the culture. Large scale propagations, adapted from the laboratory procedures, have been conducted successfully in a commercial yeast plant.

Cooperative work for further evaluation of these feed supplements is being continued with industrial organizations and State Experiment Stations. Efforts to raise yields of the active factors in the culturing process and to isolate and identify these constituents are also in progress. (See Utilization proposal "Development of Feed Additives from Beet Sugar Molasses")

e. Utilization of Beet Sugar Molasses as a Feed

WU-ARS

In view of the expanding use of molasses in feedstuffs, and the importance it is assuming as an economical and palatable source of digestible carbohydrates, the significance of the minor constituents takes on added importance. Before this significance can be established, however, and the physiological effects of the constituents determined, they must be identified and the quantities present be determined. A considerable fraction of the solid matter in molasses consists of still unknown compounds. Efforts are being directed by the Western Utilization Research Branch toward more comprehensive knowledge of this composition.

As set out elsewhere in this report under the heading "Composition of Beet Molasses," more than 400 analyses of molasses samples from 13 different factories have been completed. Nearly all of the amino acids, 75% of the anionic and most of the cationic constituents have been accounted for. Some of the constituents components of the purines and pyrimidines of molasses have been tentatively identified. They include adenine, uracil, guanine and hypoxanthine, and account for most of the previously unknown nitrogenous substances.

Only 75% of the anionic constituents in molasses are known. There are some indications that acids such as glyceric acid are produced from sucrose and invert sugar during the liming process and become part of the molasses. Methods for the quantitative measurement of these acids need to be developed. Development of such suitable methods and continuation of studies on the composition of molasses are planned for future work.

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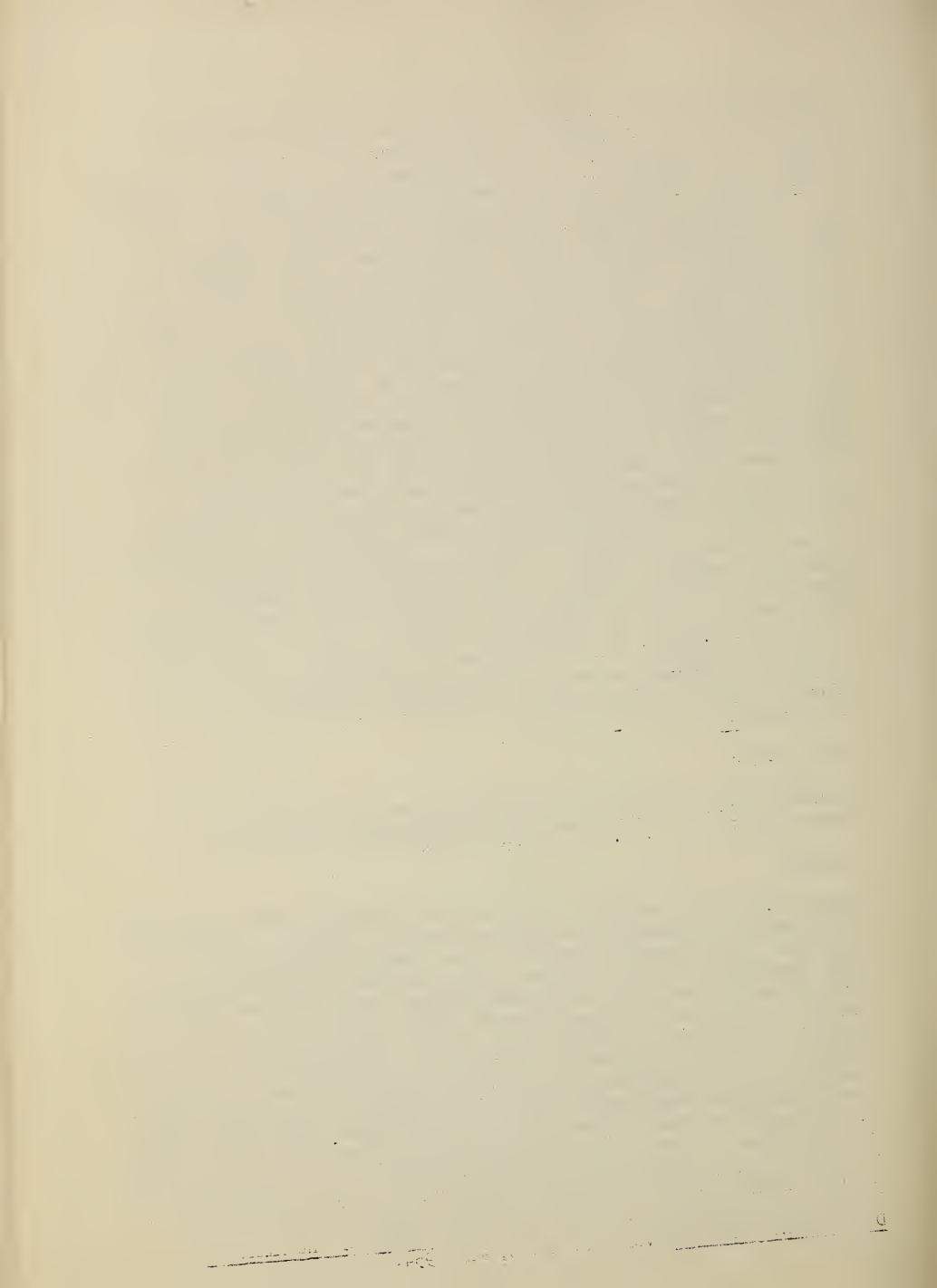
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B. PROPOSALS FOR COMMITTEE CONSIDERATION
(Order of listing has no priority significance)

UTILIZATION RESEARCH

a. Diffusion Studies

Initiate investigations to establish optimum conditions for the diffusion of sugar from beet tissues and to provide design information for the construction of diffusion equipment operable at maximum efficiency, including: (1) Studies to develop methods to kill beet tissue quickly either prior to diffusion or in the first cell of the diffusion battery; (2) Studies of the effect of time, temperature, pH and stirring on rate of removal of sucrose compared to removal of impurities from beet cossettes during diffusion; (3) Use of model membrane systems to evaluate the effect of the cell structure upon sugar diffusion. In present day beet sugar factories, the diffusion batteries constitute the first site for improved efficiency of operations and increased purity of beet juices. Currently, the first few cells of the diffusion batteries are operated at temperatures so low that the beet tissues and adherent microorganisms are not immediately killed. Diffusion of sucrose from living cells occurs so slowly that failure to kill the tissues prolongs the entire operation thus decreasing efficiency and necessitating increased diffuser size. Likewise, failure to kill the adherent microorganisms causes some loss of sucrose through fermentation. Possible approaches to (1) would be studies of humid air blanching under conditions which do not allow condensation of steam on the cossettes, irradiation by radioactive materials, and pretreatment with toxic chemicals. The information developed under (2) would provide a basis for developing the best mode of operation of diffusion batteries; such knowledge necessarily precedes the design of improved diffusers which would increase steam economy, increase the purity of juice entering the purification step, and maintain the characteristics which improve the dewatering of pulp in the presses.

b. Purification of Sugar Beet Diffusion Juice

Initiate studies on methods to purify beet juice to decrease color formation, to decrease loss of sugar, and to obtain uniform results throughout the operating season, including: (1) phase studies involving lime, amino acids and other compounds to provide necessary fundamental information; (2) methods of adding lime and carbon dioxide to obtain rapid settling and complete precipitation of removable impurities under conditions which do not encourage formation of colored compounds; and (3) use of various combinations of other chemicals such as metallic salts and ion exchange resins, in bead and in membrane form, known to form insoluble compounds with impurities of beet juice. The lime-carbonation method of purifying beet juice is effective in removing many colloids and some other impurities from beet juice. Among its disadvantages are: the required conditions catalyze formation of colored compounds interfering with white sugar production; the inability of time to remove impurities which appear late in the season and clog filters and increase sedimentation times of lime mud; the production of excessive lime salts which form scale in the evaporators; extremely careful control of first carbonation is required to eliminate some of the colloidal material.

c. Relationship of Agronomic Factors to Sugar Beet Composition and Processing Quality

Initiate investigations to establish the effect of agronomical factors on the processing quality of sugar beets. In the past 20 years in many areas sugar beets have shown a decrease in sugar content, while non-sugar impurities have increased. This has resulted in a lower concentration of recoverable sugar in the diffusion juice and an increase in production costs and molasses yields. Studies of the various constituents should be made to establish the correlation between composition and processing quality. Application of methods developed for rapid, quantitative determination of key constituents would enable establishment of the effect of agronomic practices on processing quality and would aid geneticists in selecting the most promising new varieties as soon as possible after the crosses are produced. Such investigations will necessitate close cooperation between crop production agencies who would grow sugar beets under controlled conditions and utilization research groups who would make the necessary chemical studies and carry out processing quality correlation in the sugar beet pilot plant.

d. Increased Recovery of Sugar From Beets

Expand research to devise means for reducing the preprocessing losses of sucrose from sugar beets, with particular emphasis upon studies of the relative importance of metabolism of beet tissues and the losses that occur as a result of microbial activity. These studies should be carried out under controlled conditions so that the enzymatic systems causing the losses can be isolated and antimetabolic agents can be tested for their effectiveness in reducing losses. Development of suitable techniques would permit evaluation of a great many such agents with a minimum consumption of time, effort, and material. Arrangements should then be made to test in commercial operations any agents which in the laboratory showed promise of reducing these preprocessing losses, which are currently estimated to be as much as six million dollars per year. These studies will continue to be carried out in cooperation with production research groups. (See Utilization p. 44)

e. Development of Feed Additives from Beet Sugar Molasses

Expand work on identification and characterization of the growth promoting substances produced by different microorganisms capable of utilizing low-cost sugar-rich materials such as beet sugar molasses in the media. Feed supplements derived from bacteria including proteins, vitamins, and antibiotics offer a most promising means of increasing the efficiency of animal feeding as demonstrated by tests now in progress. As soon as the active substances can be isolated and characterized, the work should logically be followed by the development of large-scale fermentation processes, utilizing molasses or other vegetable by-product substrates, in which optimum production of the desired growth promoting substance can be achieved. Attention should also be given to development of the most stable form of the product for use as a feed supplement in order to insure against loss of potency during storage. (See Utilization p. 54)

f. Correlation of Composition of Sugarcane and Cane Juice with Processing Quality

Expand research on the isolation of sugarcane and juice constituents to provide a complete inventory of the nonsugars present. Enlarge pilot plant research to include additional phases of processing such as filterability of clarification residues and crystallization of sugar. Development and application of the latest analytical techniques to the juices studied in the pilot plant will make it possible to discover the relation of key constituents to the processing behavior of the material and yields and quality of sugar obtained. Such data will be of immediate value to plant breeders in facilitating the selection of the most promising new seedlings, and will also be applicable to the development of improved processing methods for handling the new varieties as they are introduced. (See Utilization p. 41)

g. Determination of Processing Quality

Expand pilot plant experiments to include, in addition to clarification, studies of all of the steps of raw sugar manufacture, including determination of yield and quality of sugar in relation to processing behavior of the newer varieties of sugarcane. Information on the critical clarification step in juice purification has been useful in determining the most suitable of the newer varieties for commercial introduction, but more data on behavior of different varieties in all of the processing steps, including yield of sugar, will make possible a better evaluation of varieties for raw sugar production. Such complete information also is required in order to establish the correlation of juice composition with all of the factors governing the efficiency and economy of raw sugar manufacture. (See Utilization p. 46)

h. Refining Quality of Raw Sugar

Expand work on characterizing impurities that impair quality of raw sugar for refining purposes. Practical and economical means for eliminating such impurities may be more readily devised at the raw stage of cane sugar manufacture, thus improving quality of the refined product for bottling and other uses. (See Utilization p. 47)

i. Sugar in Confectionery

Expand research to determine the grades and types of sugars most suitable and economical for the production of different classes of confectionery. The second largest industrial use of sugar could be increased by determining the optimum quality of sugar for production of each type of candy at minimum cost and with the requisite quality for wider sales. (See Utilization p. 48)

j. Direct Consumption Ion-Exchange Sugar

Provide for larger scale development research on the process for purifying clarified juice by ion-exchange to yield a high grade, direct consumption sugar suitable for candymaking and other specific industrial uses. (See Utilization p. 47)

k. Floc Formation

Expand research to establish the chemical nature of the floc formation and to devise methods for its elimination. The problem is of growing concern because floc is encountered with increasing frequency as larger quantities of sugar from cane refiners are consumed for bottling uses. (See Utilization p. 47)

l. Improved Molasses-based Feeds

Initiate a systematic investigation of the combination of blackstrap molasses with various carriers to develop improved feed products. Experimental work is needed to correlate quality of feedstuffs and suitability for shipping with individual constituents of the molasses used. The reactions of ammonia and other nitrogen carriers with molasses should be investigated. Dried molasses feed products using fine bagasse or corn germ meal as carriers are being successfully marketed on a limited scale. Improvement of such products to satisfy the requirements of a much wider market will depend largely upon the application of the results of fundamental studies.

m. Production and utilization of Levulinic Acid from Blackstrap Molasses

Initiate research to develop practical methods of producing and purifying levulinic acid from blackstrap molasses and converting it into industrially useful chemicals.

New outlets for byproducts produced in sugar manufacturing can be developed by further exploration of the chemistry of levulinic acid and the synthesis of wide variety of organic chemicals for which it can serve as the starting material. The initial step in this program should be a concerted effort to develop practical and inexpensive methods of producing levulinic acid from the sugars in molasses which, in periods of surplus production, provide the cheapest form of sugar as raw material.

n. Improved Outlets for Bagasse

Expand studies on the development of improved uses for fiber and pith from bagasse. The development of bagasse fiber as a commercial source of high-quality fiber will not only provide a superior outlet for this byproduct but is expected to result in the production of papers and boards of improved quality, either when used alone or in admixture with wood pulps. The exceptionally high absorptive capacity of the fiber-free pith offers opportunities for developments in feeds and industrial applications. (See Utilization pp. 51 & 52)

o. Increased Use of Honey by the Food Industry

Expand investigations leading to increased use of honey by the food industry. In the background of this proposal is the pollination of crops. Some 60 crops, notably legumes and tree fruits, require bees for pollination. The direct object, then, is to increase the use of honey so that an adequate number of bee colonies will be maintained. To assist in stabilizing the

honey market, honey must be in a more nearly competitive position in food manufacture. To attain this, advantage should be shown to result from its use. This use may involve such factors as flavor, stability, appearance and nutritive value. Also, such factors as improvement in methods of shipping, buying, storing and in-plant handling of honey in the food industry should be considered. Furthermore, fundamental investigations on the composition and properties of honey as it may relate to these studies should be undertaken.

p. Improved Methods for Determining the Palatability of Food

Initiate studies to develop laboratory methods and procedures for determining the quality characteristics generally associated with consumer acceptance of food. Emphasis should be given to devising and standardizing methods for the sensory evaluation of food quality. Basic physiological, psychological, biochemical, and electro-chemical reactions involved in sensory methods of evaluating food quality should be investigated in order to better understand the mechanisms involved. Supplementing sensory evaluation of such quality factors as color, flavor, and texture parallel research should be undertaken to develop and standardize selected objective methods of measuring the physical, chemical, and histological attributes of foods. Also, new and improved experimental designs and statistical procedures would be developed.

q. Nutrition Studies Using Honey

Initiate studies of the digestibility of foods with special reference to the effect of carbohydrates upon the utilization of protein. Current studies using relatively pure sources of carbohydrate (sucrose, glucose, fructose, corn destrin, corn starch, rice starch, potato starch and wheat starch) indicate that nitrogen balance in adult rats is dependent upon the kind of carbohydrate in the diet. Also, when the protein intake is restricted, the composition of the liver is affected by the source of carbohydrate in the diet. It is proposed to include honey among the carbohydrates studied to determine its effect on utilization of pure amino acids and also of natural food proteins.

III. MARKETING RESEARCH

A. PROGRESS ON WORK UNDER WAY

1. IMPROVEMENT IN MARKET ORGANIZATION AND FACILITIES

a. Industrial Molasses

MOC-AMS

A profitable market for industrial molasses continues to be a serious problem to the sugar industry, with the fermentation alcohol potential declining because of the competitive advantage in producing alcohol from petroleum byproducts, and the enlarged synthetic alcohol producing capacity. The most important factors for continued operation of some fermentation alcohol facilities have been given as (1) the existence of large supplies of hi-test molasses from Cuba, (2) the ability to meet fixed costs of making alcohol with existing facilities, and (3) below-feeding-value prices for molasses.

Work was begun during the year on an economic analysis of the feed market for molasses. A survey has been planned and is now being completed to obtain data on molasses distribution and use in the livestock feed trade. Groups being contacted for primary data are:

- Tank-truck distributors
- Dried molasses product manufacturers
- Feed mills that make formula and custom-mix feeds
- Brokers and retailers of dried molasses products
- Farmers who use dried molasses products
- Farmers who use liquid molasses

The data already suggest several points of interest. (1) Increases are occurring in number of mills using molasses for feed mixing, in volume used per unit of feed mixing, in volume used per unit of feed made, and in number of types of feeds in which molasses is used.

(2) Many mill operators report that molasses will be used in feeds at present levels so long as its price per unit of feed value is equal to or below that for corn. This means that in many areas a considerable advance in molasses prices, relative to corn prices can occur without decrease in demand for molasses by feed mills. (3) The drought in many livestock producing areas has brought a new interest by farmers in molasses. It is believed that a successful experience will result in continued use of molasses in more normal periods.

(4) Dried molasses does not appear to be making the gains in use that liquid molasses is making. High cost relative to other feeds, inability to use with roughage in the manner of liquid molasses, lack of molasses odor, dust-settling and binder characteristics, and availability are the factors most frequently cited for its non-use.

(5) The area served by distributors of liquid molasses in tank-trucks and in drums and other containers is expanding. A system of distribution with terminals for rail delivery and truck pickup has been set up to cover most of the inland areas, and marketing agencies have been organized to deliver molasses regularly to the livestock feeding industry.

A report of findings is planned for fiscal year 1956, with possibility of a preliminary report on some phases of the study made public near the end of fiscal year 1955.

b. Sugarcane

MOC-AMS

The phase of work concerning the determination of the commercial value of clean, properly topped sugarcane compared to that harvested by conventional mechanical methods has been completed. Mill test data comparing clean fresh cane versus conventional harvested cane were collected during the 1951, 1952, and 1953 harvest seasons. Analysis of the data has been completed and a report of the findings is now being prepared for publication during the latter part of fiscal 1955. The impracticality of hand-harvesting methods for the delivery of clean, properly topped cane in Louisiana has been proven by data derived from the study. The net gain in yield, however, may be applied to the increased cost of new mechanical harvesting equipment to perform this extra cleaning operation.

During the three year period of the mill tests, the average increase in total payments to growers for clean fresh-cut cane was \$0.25 per gross ton of stripped cane and \$0.19 per gross ton for stripped and topped cane. The percentage increases were 3.60 percent and 2.74 percent per ton respectively.

With completion of this report, further work on sugarcane marketing will be suspended in favor of other lines of work.

c. Raw Sugar

MOC-AMS

Research devoted to raw sugar marketing problems is in the planning phase.

It is planned to pay particular attention to the economic effect of the widespread adoption of such selling methods as "season's average price" and "price-date of arrival." Appraisal also will be made of the relationship of storage, financing, pricing, and institutional factors on marketing methods.

This work will be continued in order to make such recommendations as may be practical to broaden the base for raw sugar pricing and reduce the adverse effects of isolated sales and movement of "distress" sugar or other sales practices, and otherwise to suggest changes in marketing methods and practices which will reduce costs and increase marketing efficiency for raw sugar.

d. Synthetic Sweeteners

MOC-AMS

Work on the place of synthetic sweeteners in the sugar marketing problems has consisted only of tentative planning. Personnel is not expected to be available until the studies of bagasse use and sugarcane trash are completed. Study will be devoted to this line on an increased scale in the last quarter of fiscal 1955 and in fiscal 1956.

e. Bulk Handling of Raw and Refined Sugar

MOC-AMS

Research devoted to bulk handling of raw sugar and refined sugar will run concurrently with the research on raw sugar marketing. It is now in the planning stage. It is planned to collect marketing-practices data on bulk handling operations at the same time as on raw sugar, and from many of the same producers and marketers. Factors such as costs, facilities, labor conditions, which are common to both bag and bulk handling and to shipment of raw sugar will be analyzed. This line of study will be continued into the marketing of refined sugar in dry bulk lots in order that analysis of the feasibility of bulk handling, and any economies resulting, will be available for all segments of the industry.

f. Sugarcane Sirup and Edible Molasses

MOC-AMS

This work is presently discontinued. Analysis of information gained through personal interviews of sirup producers, packers, industrial users, and other interested parties has been completed. A report containing a description of sirup production and current marketing conditions, methods, and practices that appear to have contributed to the recent decline in production and marketing of sirup has been prepared and been circulated within the Department. It has been concluded that information now available is insufficient to account fully for the declines in production and to support recommendations for improvement within the industry. Consequently the full report has not been released for publication. An article presenting the survey results in summary form is planned for publication in one of the periodic publications of the Department.

g. Bagasse

MOC-AMS

A report on the evaluation of the market potential for sugarcane bagasse has been completed and is being reviewed for publication. The major current use of bagasse is in the making of insulation board. Bagasse characteristics which lend themselves to insulation board manufacture are also important considerations for raw materials to make paper and paperboard products. The greatest potential market outlet for bagasse appears to be in making these types of products.

The specific products or outlets that appear to present the best opportunities for market growth, ranked in order of importance are: (1) Corrugated board, (2) kraft liner board, (3) market pulp for blending with wood pulp for making fine papers, (4) market pulp for blending with wood pulp to make newsprint, (5) dehydrated bagasse for poultry litter, (6) glassine and grease proof papers, and (7) hardboard.

Of the products studied, those that seem to offer the least promise are insulation board, paper and paperboard products other than those listed above, dissolving pulp, furfural, and agricultural mulch.

Reviewers of the manuscript, both in industry and in Government agencies, have indicated the work to be comprehensive and of interest. Publication is expected during the early part of calendar year 1955.

B. PROPOSALS FOR COMMITTEE CONSIDERATION
(Order of Listing has no Priority Significance)

MARKETING RESEARCH

a. Market Potentials for Low Order and Non-Food Uses of Sugar

Initiate studies to determine the market potentials for raw and refined sugar in low order and non-food uses, within present regulations under the Sugar Act, the Tariff Act and the Internal Revenue Code, and under possible future changes of those regulations. Studies of low order potential of raw or refined sugar would include use in livestock feed. Studies of non-food uses of sugar would include potential use of sugar as a raw material in the manufacture of such products as plastics and plasticizers, detergents, emulsifiers, insecticides, and chemicals such as glycerol, glycols, sorbitol, and other polyhydric compounds, and in the manufacture of pharmaceuticals and biologicals.

b. Analyze Refined Sugar Marketing Practices

Initiate studies of the refined sugar market for the purpose of promoting marketing efficiency. This work will include an appraisal of economic elements and marketing practices associated with (1) distribution of market risks, (2) buying and selling practices, (3) accumulation and maintenance of stocks, and (4) price changes and price change policies. Knowledge of effects and maladjustments which are, or can be, created in any of these aspects by actions of individuals in marketing sugar will assist in marketing decisions and promote more orderly marketing.

c. The Sugar Market

Undertake the development of a detailed construction of the market for sugar and establish the location of users by type and size; area sugar use as affected by seasonality, population shifts, transportation media; and other factors that contribute to variation of distribution patterns. This work would provide more detailed information on the structure of the sugar market than is now available and enable better understanding of the demand forces given play in the market.

d. Maple Sirup and Sugar

Initiate a study to determine what changes in market organization and marketing practices are needed to improve the financial position of the maple industry and to increase marketing efficiency. The maple industry has declined in importance and many farmers have lost an important source of farm income. Even further declines are possible under existing practices unless changes are effected to improve marketing conditions.

IV. MARKETING SERVICE AND EDUCATION

A. PROGRESS ON WORK UNDER WAY

1. EDUCATIONAL WORK OF FEDERAL EXTENSION SERVICE
2. SERVICE WORK OF STATE DEPARTMENTS OF AGRICULTURE AND BUREAUS OF MARKETS
3. SERVICE WORK OF U. S. DEPARTMENT OF AGRICULTURE

a. Statistics on Sugar Beets, Sugarcane, and Maple Products AES-AMS

Data on acreage, yield and production are published for sugar beets, sugarcane for sugar, and seed and sugarcane for sirup. Data on trees tapped and production of maple sugar and maple sirup are published for maple products. Prices received by farmers and value of production are published for all of above sugar crops plus disposition and value of sales for maple products and sugarcane sirup. Final acreage, production and prices for sugar beets, sugarcane for sugar, and sugarcane for seed are based on reports made by sugar companies to the Sugar Division of the Commodity Stabilization Service.

This work will be continued on about the same basis as in the past year.

b. Scheduled Reports

FAS

Regular world summaries of world sugar production are scheduled for the first week in November and the first week in May. A regular world summary of sugar beet production is scheduled for the first week in October. During the current fiscal year, the following scheduled summaries have been released in the publication Foreign Crops and Markets:

World Production of Sugar Beets Down in 1954, released 10/18/54
World Centrifugal Sugar Production Down Almost 1.1 Million Tons, released Nov. 29, 1954.

c. Unscheduled Reports

FAS

International trade in sugar is covered in an unscheduled report released generally during the early summer. During the current fiscal year, the article International Trade in Sugar Increased 2.2 Million Tons in 1953 was released in Foreign Crops and Markets, August 16, 1954. Area surveys on sugar, previously published in circular form only, have been discontinued during the current fiscal year.

d. Supplementary Work

FAS

Statistical tables and articles are prepared annually for the following publications:

Agricultural Statistics - Statistical tables covering world sugar production and trade were prepared in July and early August for the yearbook Agricultural Statistics for publication in the near future.

World Agricultural Situation - A report on the current world sugar situation has been prepared for publication in the Foreign Agriculture Circular, World Agricultural Situation, 1955, scheduled to be released in January, 1955.

Foreign Agricultural Trade - Commodity Divisions are now required to submit a short statement and the appropriate statistical table covering fiscal year United States foreign trade in agricultural products, for publication in the circular Foreign Agricultural Trade. This article was submitted in October of the current year. A similar report is due in April 1955 for the same publication but referring to the calendar year trade of the United States.

e. Grade Standards for "Liquid Sugar" and Comb Honey

FVD-AMS

Data have been developed during the year for issuing a proposed grade standard for "Liquid Sugar." A cross section of samples from the entire industry were studied in cooperation with the Eastern Utilization Research Branch of the Agricultural Research Service. The results are being analyzed as supporting data for developing the grade standard. A permanent glass color comparator has been developed in cooperation with the Eastern Utilization Research Branch, ARS, and a draft of a proposed grade standard has been prepared.

Plans - It is planned to invite interested producers and users of liquid sugar to a meeting soon after January 1, 1955, to discuss the proposed draft of the grade standard for possible improvements prior to its publication. Samples will be available for obtaining color cut-off points with respect to classification of liquid sugar for color.

A revision of the grade standard for comb honey has been requested and data will be developed for drafting the proposed changes. (See Marketing Serv. and Ed. proposal "U. S. Standards for Grades of Sugar, Sugar Products, and Honey")

f. Market News for Industrial Molasses

FVD-AMS

A market news service on industrial molasses has been conducted since January 1951. Weekly and annual reports are issued showing prices, supply and demand conditions, market trends and other related

market information for all types of industrial molasses (cane blackstrap, beet, citrus, and hydrol), at major port terminals, interior marketing points and production points in the United States and Puerto Rico. The information is obtained by telephone, wire, correspondence, and personal contact from molasses importer-distributors, producers, brokers, and retail and wholesale buyers. Since January, reporting of cane blackstrap prices has added four new terminals at Beaumont and Corpus Christi, Texas; Wilmington, North Carolina; and Port Everglades, Florida. Menominee, Michigan, is a new terminal reporting point for beet molasses. Further improvement in the service has been made by periodic reporting in the narrative on other factors, such as pasture conditions, hay, and feed grain market activity affecting the market for feed molasses.

Reports are furnished by mail to all interested parties with some additional dissemination by the press. Reports are issued simultaneously by the Marketing Information Division of AMS, Washington, D. C.; Dallas, Tex.; and San Francisco, Calif.

g. Market News for Honey and Honey Products

FVD-AMS

Market news service has been conducted on honey since 1918. Semi-monthly reports are issued from Washington, D. C., providing current information on crop conditions in honey producing areas, demand, movement, market trends, prices in producing areas and major city markets, and other information bearing on honey markets. The information is obtained by mailed questionnaires and personal contact from beekeepers, country buyers and assemblers, bottlers, wholesalers, and others concerned with producing and marketing honey and beeswax. Reports are mailed to all interested parties with some additional dissemination by press and radio.

h. Sugar Statistics

AEC-AMS

A part of the statistical work on sugar in the AMS centers around the publication once a year of "The Sugar Situation." The last issue of this report, published in February 1954, consisted of 36 tables and a descriptive text containing information on (1) domestic production, distribution, consumption, and prices of cane and beet sugar, (2) foreign sugar production, and (3) production, consumption, and prices of sweeteners such as honey, molasses, corn sirup, and other sirups. Brief discussions of any special events of particular interest to the sugar industry are also included.

Other publications in which the results of the work on "The Sugar Situation" appear are: The National Food Situation, the Statistical Abstract of the United States, and Agricultural Statistics.

B. PROPOSALS FOR COMMITTEE CONSIDERATION
(Order of Listing has no Priority Significance)

MARKETING SERVICE AND EDUCATION

A. FEDERAL EXTENSION SERVICE

B. STATE DEPARTMENTS OF AGRICULTURE

C. U.S.D.A. SERVICES

1. U. S. Standards for Grades of Sugar, Sugar Products, and Honey

a. Expand work on development and revision of United States standards for grades of sugar and sugar products, particularly studying requirements for sugarcane sirup and refiners sirup. These standards need revision based on industry comments during the past 2 years.

b. Expand work on the development and revision of United States standards for grades of honey, particularly emphasizing requirements for comb-section honey on which industry members are requesting immediate study. (See Marketing Service and Education p. 70)

